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ENGINEERING NEWS.

THE COLUMBUS EXPOSITION PROJECT seems to have really stirred up some interest in New York, and the prospect for its being held in that city seems to be increasing, since with New York and Chicago both in earnest, New York naturally would be and ought to be preferred. Chicago claims to have a large sum of money pledged, over $5,000,000; but it is not paid in yet, and it is claimed on behalf of New York that as soon as the Finance Committee reports there will be no difficulty in raising all the money needed, the steamboat interest alone having been pledged for $500,000 by JOHN H. STARIN. On the other hand a very great drawback to Chicago is its fearful smoke nuisance, which is now far worse than in any other city in the country, and for which Chicago ought to suffer, since most of it is the result of pure negligence and maladministration. It is not yet possible to prevent something of a smoke nuisance where soft coal is used as fuel; but it is easily possible to prevent the discharge of such enormous masses of black smoke as are poured out from every large building in Chicago, and make breathing its air down town a mere "disgusting necessity" to the stranger. The natives seem to have gotten used to it.

THE SITE COMMITTEE is in session as we write, and is reported—as we hope and believe wrongly—to have concluded to recommend taking all of Central Park above 96th St. and an irregular and beautified tract to the northwest of it, joining on to it almost cornerwise. Our impression, however, founded on our own judgment of what is most expedient, is that the Inwood and Fort George site will be recommended, than which there is no more beautiful or easily accessible district in the city. Before our next issue the committee will doubtless have reported, and it may be have shown good reasons not now evident why it is indispensable to take part of Central Park. One thing may be taken as certain: The recommended site will be on Manhattan Island.

THE MANCHESTER SHIP CANAL CO. held its eighth ordinary general meeting of the shareholders Aug. 26, 1889. The chairman stated that great progress had been made throughout the works. No unforeseen difficulty had arisen in the construction of the canal. With regard to the physical nature of the obstacles they had to contend against, most excellent and easily excavated rock had been found upon all the lock sites. Two of the group of large docks at Salford were almost completed. The river derivation, which forms a portion of these docks, was also finished. The foundations of the entrance locks at Eastham had been laid, and the works at Pomona gardens was well advanced. The rock is of various characters, and some of it is used upon the works. There remains at the present time to be excavated 25,080,696 cu. yds. out of the original estimate of 44,143,284 cu. yds., and it is confidently expected that the canals will be open for traffic within three and a half years at longest. The present monthly cube is 1,000,000 cu. yds. of excavation, and the average number of men employed since the commencement of the works has been 12,000. Work was started just before Jan. 1, 1888, so that it has now been in progress some 20 months.

WORK ON THE MEXICO DRAINAGE CANALS AND TUNNEL, described in our issue of Aug. 10, 1889, is making good progress. The contract for excavating the canal, which is to run from the San Lazaro pump house to the head of the Zumpango tunnel, has been let to a London company. The canal will be several miles in length and will require 11,000,000 cu. metres of earth and rock excavation. It is to be completed by Jan. 1, 1892.

The Bucyrus Construction Co., of Cleveland, O., which has a contract on this enterprise requiring about 1,000,000 cu. metres of excavation, is well along with its work, which consists principally of dredging. Col. W. H. HARRIS is in charge of the company's operations in Mexico. It is reported that the company will secure a contract for renovating the sewerage system of Mexico.

THE NEW CRUISER BALTIMORE made a magnificent test run on Sept. 14, making 78.3 knots in four hours in the open sea, with light head wind and occasional long swell, the remains of the storm of Sept. 10, 11, 12. Hence the average speed was 19.575 knots per hour, the maximum, made in the third hour, having been 20.2 knots. The vessel was loaded down with pig iron, somewhat in excess of her service maximum. The horse power developed was 10,300, entitling Messrs. Cramp & Sons to a premium of $130,000 for the excess over the stipulated minimum of 9,000 H. P. Her average revolutions per minute were 117.4; maximum, in the third hour, 120.8. Steam pressure throughout the first three hours about 118 lbs., which ran down at the end of the fourth hour to 109 lbs., somewhat diminishing the resulting speed, this hour showing only 113.7 revolutions against 117.3, 119.0, 120.8 for the first three hours. The air pressure in the fire room varied between 2.0 and 2.7 ins. The engines worked smoothly throughout; no water was used except a little on one crank-pin on one occasion.

THE BALTIMORE'S HULL was designed by Mr. W. H. WHITE, late with Armstrong & Co., now Chief Naval Constructor of the British Admiralty. Her engines were made by Cramp & Sons, her builders. She is of 4,400 tons burden, and the plan for her hull was rejected by the Spanish Government in competition with that of the *Reine Regente* and others, that ship being more than 1,000 tons larger, and having made the remarkable run of 21.5 knots *on the measured mile* in smooth water, which run, however, is far surpassed in excellence by the four-hour run of the *Baltimore*. The *Vesuvius* made 21.646 knots on her trial, developing 4,295 H. P., with 160 lbs. steam, or about 6 H. P. per ton burden. The *City of Paris* on her last record-breaking trip, made 20.014 knots per hour *average* across the ocean, but she is of 11,000 tons, and has 19,000 H. P.

THE *Baltimore* is now said to be the fourth fastest cruiser in the world. The *Vesuvius* comes first; the Italian *Piemonte*, built especially for speed, and having 12,700 H. P., with only 2,500 tons displacement, comes second, with a 22.3 knot record in the measured mile; the *Reine Regente*, 4,900 tons and 11,500 H. P., comes third, with 20.6 knots on a four-hours' run. The *Philadelphia* and *San Francisco* have slightly less draught, finer lines, more boiler power, and better engines than the *Baltimore*, and are expected to show 21 knots.

THE *Charleston*, another English designed hull, with American engines (in that case merely modified), made 19.5 knots at sea, while her prototype, the *Naniwakan*, made but 18.9 knots after 21 trials. The *Baltimore* turned in a complete circle of 239 yds. diameter in 6 m. 58 sec., and a circle of 750 yds. diameter by the rudder only. With full speed ahead and reversed engines, she stopped in 2¾ minutes, almost her own length.

FLOODS AND LANDSLIDES of great extent are said to have occurred recently in Japan. In August a river broke its banks and caused great devastation, submerging villages and crops, and leaving the people dependent on outside contributions for food. These floods caused the sides of hills to give way, sliding down to the plains, and burying villages. The number of lives lost is given as 15,000.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a collision Sept. 16, at Tioga Junction, Pa. An express train on the Tioga branch of the Erie railway could not be stopped at the station owing to a failure of the brakes to act, and it ran into a locomotive of the Fall Brook railway. Four cars were wrecked, and the wreck caught fire. Two persons were killed and 11 injured.——The misplaced switch accident is again repeated, this time at Colliers, W. Va.; an express train was turned into a side track and the engine and two cars were derailed, the engine going over the embankment. There is said to be no regular switchman at this place; a yardmaster is in charge, but conductors of trains passing through this switch are supposed to close it when their train has passed.

HEAVY STORMS have occurred in Pennsylvania, and several small bridges have been carried away by floods. Washouts are reported from Arizona, Virginia and Pennsylvania.——The dam of the Kennebec Ice Co., near Coatesville, Pa., gave way on Sept. 17, and the rush of water carried away a bridge just below the dam.

BRIDGE ACCIDENTS are reported as follows: A small bridge on the Norfolk & Western, near Lynchburg, Va., gave way under a passenger train, Sept. 14, having been weakened by flood; nobody was seriously injured.——A bridge over the Patoka river near Patoka, Ind., on the Evansville & Terre Haute, gave way under a freight train Sept. 16. Near Honeybrook, Pa., 11 bridges have been washed away.——A bridge on the Central Pacific near Truckee, Cal., was burned Sept. 12.

A PLAN FOR THE STORAGE OF THE NILE FLOODS was recently presented before the British Association at Bath, England, by COPE WHITEHOUSE. He estimates that a reservoir capable of supplying the Nile at low water with about 1,700,000,000 cu. ft. a day for 100 days could be constructed for about $2,500,000. The canal through which the excess of the Nile flood would flow to this large reservoir could be excavated in 300 days by the removal of about 100,000,000 cu. ft. of sand. The site for the reservoir would be a depression known as the Raian basin, which is believed to be the site of the ancient Lake Mœris. Mr. WHITEHOUSE thinks that his project would make possible an increase by more than one-third of the productive wealth of Egypt. He also states that the works would be mainly the utilization and restoration of dikes, canals, and physical characteristics in actual use for the same purpose during 2,000 years, and, in part, in continuous operation from B. C. 1800 to the present time.

A PEARSALL HYDRAULIC ENGINE for raising water by water power was erected Aug. 23 at Isabella Furnace, Barneston, Chester Co., Pa., and has been carefully tested since. The results, as reported to us, are most excellent. Mr. WM. M. POTTS, Manager, certifies that the hydraulic engine is entirely satisfactory, and more than fulfils the conditions of the contract. It works with a fall of 17.15 ft. and delivers water to a reservoir on an adjacent hill 94 ft. above the engine through a 4-in. pipe 600 ft. long, giving an actual resistance of 101 ft. The quantity of water used is 137 cu. ft. per minute, and the quantity delivered to reservoir, according to the lowest of two sets of measurements, is 125 galls. per minute, showing an actual efficiency, or ratio of net useful work to gross power, of 72 per cent. The size of flow pipe is 1 ft. diameter. We shall give illustrations and a fuller description of the machine next week.

THE CHICAGO, ST. PAUL & KANSAS CITY RAILWAY CO., which finds itself without means to pay the interest on the bonds falling due Jan. 1, 1890, has submitted the following proposition to the first mortgage bondholders. To permit the next three years' coupons on the first mortgage bonds to be constituted a lien prior to the principal and subsequent coupons, and to be deposited with the financial agents of the company at London, who will issue therefor certificates, with coupons attached bearing 5 per cent. interest, maturing on Jan. 1, 1894. These certificates shall constitute a priority loan. The company agrees not to pay interest on income bonds or dividends on stock until this priority loan is canceled in full and the preferred stockholders have entered into their full rights. It is thought that this respite will not only secure to the bondholders the payment of the interest in full at the end of three years, but will accumulate a surplus sufficient to guard against bad times.

THE INTERNATIONAL RAILWAY CONGRESS, now in session in Paris, is attended by delegates to the number of 516, credited as follows to the various European countries: From France 116, Italy 90, Russia 77, Belgium 67, Austria 38, Great Britain 31, Spain 22, Portugal 13, Switzerland 9, Denmark 6, Rumania 6, Sweden 6, Servia 6, Turkey 1, Greece 1, Germany 1.

The fact that the German Empire, with its great railway mileage, is represented by a single delegate is an evidence of the general hostility in Germany toward France and her people. The convention will chiefly discuss matters of railway practice in which uniformity is desirable. Its deliberations, therefore, are of little interest to Americans. We sometimes think that our progress in this country toward uniform standards is very slow; but when we see the disadvantages which those labor under who attempt to further uniformity on the continent of Europe, we may well congratulate ourselves that our circumstances here are so favorable.

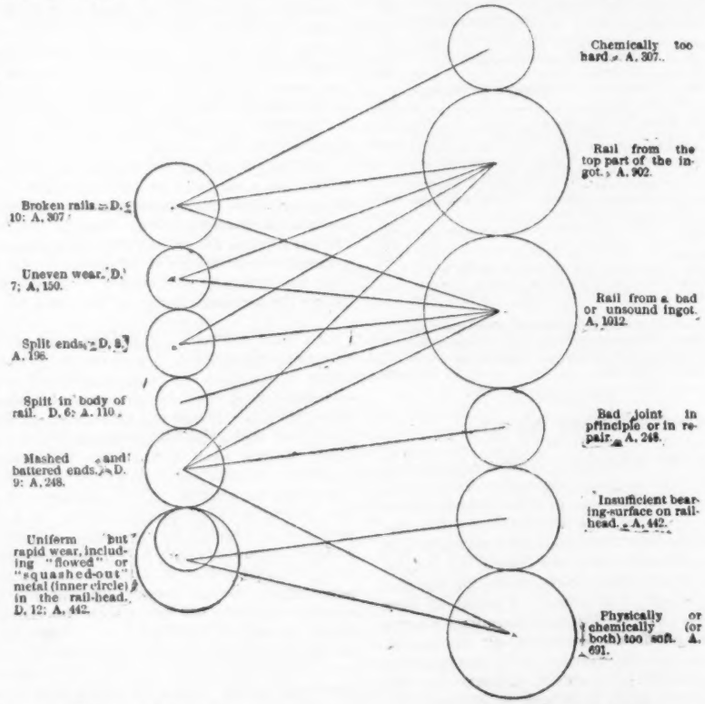
THE BRAZOS RIVER IMPROVEMENT is being pushed by a force of 500 men, and with the single jetty now partially completed a depth of 9 ft. has been secured on the bar at mean low tide. The depth when work began was but 4 ft. General Manager ANGLE expects to increase the depth to 20 ft. by spring. The company is to send an engineering party into the field early next month to survey railroad lines to Llano and to Waco.

WORK ON THE COLUMBIA RIVER JETTIES is making fair progress. An inspection of the work has just been made by Col. GEO. E. MENDELL and Maj. T. H. HANDBURY, U. S. Engineers. The tramway was extended 1,436 ft. during August and is now over two miles from shore; the mattress-work and rock-work is kept as nearly up with the tramway as practicable. During August, 12,400 tons of stone and about 15,000 cords of brush were placed on the jetty. The present appropriation will keep the work going till the end of the season, and if there is no delay in beginning work next spring, the jetty, which is to be about 4¼ miles in length, will be about completed by the end of next season.

THE NEW DRY-DOCK at the Portsmouth Navy Yard was opened Sept. 19 at which time a cruiser was docked. We have heretofore given a description of the dock, which is regarded as a very satisfactory piece of work. It is 530 ft. long over all, taking a ship 430 ft. long, 26½ ft. draught, and any width. The foundation is piling capped by 3 ft. of concrete, above which 2,000 M. ft. of timber are used, half of it Georgia pine, and the other sticks, where exposed to the teredo, creosoted. The side of the dock steps back 10 ins. for 8 ins. rise. This is the first of three docks which the contractors, J. E. Simpson & Co., have contracted to build for the Government, and the eleventh one built by them altogether, the first having been built in 1856. The dock cost $495,708 against $974,357 for the stone dock alongside, only 300 ft. long, and built in 1833. The dock holds 8,000,000 galls. of water, and was emptied by the two centrifugal pumps, built by the Southwark Foundry & Machine Co., of Philadelphia, in 1 h., 5 m. 26 sec.

Certain Conditions in the Manufacture of Steel Rails which may Greatly Influence Their Life in Service.*

In adding one more to the list of papers that have been presented on the subject of steel rails, I wish to explain at the beginning that in enumerating the steps in the manufacture which, I think, have an all-important effect on the wearing qualities of the rail produced, I do so with no little hesitation. As a student in the field, I am anxious for the opinions of others, and have finally decided to ask for it in this way. I have not stated everything which I think affects, in one way or another, the life of rails, but have confined myself to those steps in the manufacture which I felt most sure did do so. Recognizing the danger of being carried away by enthusiasm, I have endeavored to make my assertions with caution, and to understate my case rather than to overstate it; but if I have succeeded in throwing a ray of light on this vexed question, and placed it in the eyes of some railroad men in an aspect which they have not fully considered, my boldness will be more than justified.


Chemically too hard. A. 307.
Rail from the top part of the ingot. A. 902.
Broken rails. D. 5 10; A. 307.
Uneven wear. D. 7; A. 150.
Rail from a bad or unsound ingot. A. 1012.
Split ends. D. 8. A. 196.
Split in body of rail. D. 6; A. 110.
Bad joint in principle or in repair. A. 248.
Mashed and battered ends. D. 9; A. 248.
Insufficient bearing-surface on rail-head. A. 442.
Uniform but rapid wear, including "flowed" or "squashed-out" metal (inner circle) in the rail-head. D. 12; A. 442.
Physically or chemically (or both) too soft. A. 691.

EVILS OR FAULTS IN RAILS TO BE AVOIDED. CAUSES THEREFOR.

Relative Magnitude of Evils or Causes of Failure in Steel Rails, and Consequent Relative Importance of the Causes of those Evils.

[D. = diam. in $\frac{1}{16}$ in. A. = Area in 0.001 sq. ins.]

1. *Uniformity in the quality of the material charged into the converter assists the attainment of uniformity in the steel produced.*—This is the argument which is used by the champions of the cupola-melting or indirect process, and has considerable weight. It takes vastly more skill to make good steel if there is a great irregularity in the iron charged into the vessel than if there is not this irregularity; but, on the other hand, there are certain advantages in the direct method, such as a lower sulphur-percentage from the same furnace-iron, while it is possible to get as great uniformity in the iron charged by having the furnace-capacity enough in excess of the demands from the converting department to allow for occasional "slips" in the furnaces, and permit the mixing of the iron from two furnaces, which are respectively too "hot" and too "cold."

2. *Care in pouring ingots at the proper temperature into warm moulds, and the treatment of ingots before rolling, have important effects on the rails made from them.*—In other words, many of the failures in rails and the uneven wear of rails are often traceable to bad ingots, which may result from careless pouring, spattering the sides of the moulds, or stopping partially or entirely the flow of metal from the ladle to the ingot. Cold moulds produce "flaws" and "checks" in ingots, and the use of moulds so hollowed and burnt as to require an hydraulic ram to push out the ingots also does it.

3. *Increasing the diameter of rail-ingots may be a positive injury.*—(a). The pressure between the rolls should increase as the square of the diameter, if large ingots are to be forged as thoroughly as small; yet by driving the rolls more slowly, their effect can be made to penetrate more deeply to the center of the ingot. (b.) The amount to be cut from the top of the ingot to reach soundness is by weight a certain percentage of the cross-sectional area, and therefore must increase as the square of the diameter. (c.) Increased height, within practical limits, gives an increased amount of metal that is sound, since the soundness of any part of the ingot should be proportional to the weight of the metal above it.

In these three ways, I think, the proportions of ingots have an important influence. First, that the power of the forging press, the rolls, or the steam-hammer must increase certainly with the area of cross-section or as the square of the diameter, and that, unless this is done, the forging effect is superficial and not thorough. With rolls this effect can be made to penetrate more deeply by simply allowing more time for the pressure to be transmitted through the semi-rigid mass, *i. e.*, by slower rolling. With high-speed rolling, the effect is like that of a light, quick-striking hammer, and an index of its superficiality is to be seen in the hollow, cup-shaped ends.

Second comes the question of the amount necessary to cut from the top of the ingot to reach soundness, and how this is affected by changing the proportions of ingots. The distance from the top to which the central funnel-shaped cavity and dispersed honeycombs will extend (conditions being equal) is about the same, irrespective of the cross-sectional area, and hence is by weight proportional to this area, or varies as the square of the diameter.* It seems but reasonable that if we keep the top of the newly-poured ingot fluid as long as possible (as by throwing on charcoal or coke-dust), and keep the ingot erect until the fluid interior has solidified (most easily done by heating in furnaces in which it stands in the same position as it was poured), we shall enable this cavity and general unsoundness to exist near the top; whereas, if by throwing on water or by "stoppering" we solidify the top of the ingot, we shall oblige the unsoundness to exist further down in the ingot. Third, it seems but a corollary to this proposition that the soundness of any

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*A paper by FREDERIC A. DELANO, Chief of Bureau of Rail and Rail Joint Inspection Tests and Records, C. B. & Q. R. R., Chicago, Ill. Read before the American Institute of Mining Engineers.

*At most mills, the bloom goes to the shears "top" end first, which seems to me so wasteful that I speak of it here. Even granting that the "bottom" end needs some trimming, it would be better to trim that first, and then cut off the amount left over at the top, instead of cutting from the top end first, which not infrequently results in wasting more from the bottom end than has been cut from the top.

part of the ingot is roughly proportional to the height of metal above it. This theory could not be pushed to extremes, since there are sound, practical reasons against making the mould too tall and slender.

4. *Rolls intended for the blooming of ingots by rapid reduction at each pass* (1) should be larger in diameter in proportion as the reduction per pass is larger; and (2) should be designed (as, for example, universal or "V" shaped rolls) so as to support the metal on all sides during the rolling, and thus prevent the formation of little cracks and tears in the unsupported part.*

The first statement is reasonable and needs no explanation; and in regard to the second, I think I am speaking within reasonable bounds in saying that, as rolling is more rapid, or as the amount of reduction per pass is greater, the width of unsupported metal between the collars is more subjected to cracking and tearing. This trouble would be overcome, I think, by "V" rolls; but I confess I have never seen the experiment tried, and may be mistaken.

5. Rolling long-length rails certainly lessens the waste, and a mill rolling long lengths can better afford to throw away a long rail-end at the top than a mill rolling short-length rails; but besides this, it influences the temperature at which rails are finished, though the coolness at which it is possible to finish rails of the existing type of section is really limited by their shape. This brings me to my fifth proposition—*that the hot rolling of rails necessitated by the present shape produces a rapidly-wearing rail.* This hot rolling and extremely hot finishing produces a metal loose in structure; and the head of the rail, particularly hot when finished and cooling very slowly, is on this account rapidly worn away as soon as the the outer skin is worn off. Already the weight on the driving wheels of many locomotives is sufficient to "squash and flow" the metal in the rail-head of many of the rails manufactured nowadays, and there are only two ways in which this trouble can be met—which brings me to my sixth proposition.

6. *The only way to materially increase the life of rails involves a change in the ordinary type of rail-section, in order to (1) increase the bearing surface between the wheel-tread and the rail, so diminishing the weight per square inch; (2) to increase the hardness or, more accurately, the compressive strength of the metal, (a) by increasing the compactness or physical hardness of the metal (only possible by colder rolling), or (b) by increasing the chemical hardness (only possible, with safety, in a section less liable to internal strains).*

It is evident that it will be of little use to increase the width of our rail-heads unless there is some change in the shape of locomotive tires; for, of the eighty or more different types in this country, only a few when newly turned up get a bearing across the entire width of present rail-heads, and the shape of many rails, taken out of track, attests the condition of the tires, and proves that the rails were worn out before their time while acting as grindstones, on which the tires have had their "coning" worn down to an even bearing.

Many engineers have calculated the strength of their section on the assumption that the metal in all parts of the section was of equal strength, as if a rail had been planed out of a rectangular bar. What better instance that they have done so do we need than the experiments (so much talked of) made by the late Baron VON WEBER, of planing down a five-eighth inch web to ascertain what would be a safe minimum thickness? Much, too, has been sacrificed to making a rail for the joint, a sacrifice well worth making, perhaps, if a good joint be unattainable otherwise. The important thing is to know how much we are sacrificing, and how much we are getting for our sacrifice. I cannot but think that if engineers realized the sacrifice, we should see a splice-bar devised which would be as good as the best, and yet suited to the best form of rail.

In the question of hardness as affecting the life of rails, first brought into prominent notice by the careful investigation of Dr. DUDLEY, there seems to have been no distinction made between the two different kinds of hardness—that which results from greater compactness of the metal, which I shall call *physical* hardness, and that which comes from the chemical composition, which I shall call *chemical* hardness. Supposing the surface of a rail to be in reality rough, resembling, when much magnified, a roughness like that on the soles of rubber overshoes, it is conceivable that these roughnesses should be so brittle as to break off, but it is clear that the greater the physical hardness the greater will be the tenacity and resilience of these minute roughnesses. Physical hardness has, in fact, this distinction from chemical hardness, that it does not entail brittleness—is diametrically opposed to brittleness. Resilience and toughness are as necessary to increase the life of rails as they are necessary for safety, yet it follows that for a given toughness, resilience, or elasticity, the greater the hardness the greater will be the wearing capacity. Hardness due to chemical composition is, we say, coupled with brittleness; but it will be admitted that, for any given chemical hardness, the brittleness increases very rapidly as we approach a shape liable to internal strains, and, the limit of brittleness being the "danger-line," chemical hardness is more possible as we approach a shape of section not liable to internal strains. As I have already said, the weight on engine-drivers is even now sufficient, with the bearing surface attained, to "squash" and "flow" the metal in the rail-head of many of our rails. Increased strength to resist these compressive strains is given by greater hardness, physical or chemical; but may we not have reached a point where a greater chemical hardness would be unsafe, yet greater physical hardness impossible, until we have a section which will admit of slower rolling and colder finishing?

7. *Rails, if anything but straight, should be a little low in the center and not cambered.*—Many rails go into track with a perceptible camber in them, a practice which has grown up either because the supports on which the rails are inspected are more than 15 ft. apart, or because of a notion of rail inspectors that a rail, like a bridge, should be slightly arched. This, of course, is absurd; and if anything but straight, it would seem better that the rail should "sag" slightly in the center to partly compensate for the lengthening by service of the upper fibres of the beam.

8. *Our present knowledge does not justify us in stating the composition of steel which will give the best wearing rail for the least money, but it seems probable that sections permitting colder rolling and less liable to internal strains will safely allow greater latitude of composition, and yet have good wearing qualities.*—So many men believe that if we could analyze every rail we should at once know how it would wear and all about it that to them the consideration of the mechanical conditions of manufacture seems useless. The fact is that analyses of rail-steel tell very little, and a man could about as well judge the value of a piece of granite as a building-stone from knowing the exact amount of silicon in it, as he could judge the quality of a rail from knowing the amount of carbon, phosphorus, silicon, manganese, and sulphur in it. Metallurgical chemistry has made and is making great strides; but, as chemists will admit, they cannot yet tell how these elements are combined with the iron, whether they influence the whole "matrix" or whether they are combined wholly among themselves as particles of foreign matter, local in their effect and insignificant. We know more about the effect of carbon than that of any other metalloid which combines with iron in steel, and we know that its condition is greatly affected by sudden or unequal changes of temperature. May it not be so with the other elements? Since we know that phosphorus produces a tendency to coarse crystallization, and that it is probably more potent than carbon in producing internal strains, may we not infer that if it be important to avoid internal strains and slow cooling from a high heat with carbon-steel, it is doubly important to avoid it with steel containing notable amounts of phosphorus?

The all-important consideration of getting a rail-section admitting colder rolling will not necessitate our going back to the old pear-shaped section, but it probably will require a slight thickening of the web, increasing the slope-angles above and below to say 18° and increasing the fillets connecting the web with the base and head to ¾ in., limiting the height and width of base, for a rail of 75 lbs. or under, to 4½ ins.

A vast amount of money has been thrown away in making analyses and physical tests of rails about which little or nothing was known, and after the study of records upon records of analyses which only seem intended to bewilder and confuse, I feel justified in saying that a small part of this money judiciously spent would have given us an immense amount of valuable information which we now lack. If every large railroad company in this country should begin now, and, choosing one rail in every thousand tons ordered, make some practical service-tests, we should begin in a couple of years to learn something about our subject. The clause which I would suggest including in rail-contracts would be:

The representative of the railroad company shall pick out one rail for every 1000 tons, or fraction thereof ordered (on which is distinctly stamped the heat number), and this rail shall have one foot in length sawed off cold from each end. The 28-ft. length shall be *daubed* (on the web and flanges) conspicuously with paint, and the short pieces stamped so that it will be known without possibility of error from what rail they have been cut, and to which end they belong. The painted rails and the short pieces shall be kept together by the rolling-mill company until the completion of the order, and then forwarded to the railroad company.

My idea would be to test all the 28-ft. (painted) rails of one year's make by putting them at one time into a piece of track where they would have practically identical service, and where they could be watched. Any additional refinements which could be added—to record the numbers of trains, the tonnage, etc.—would be of great use; but even without them, much could be learned by simply watching the comparative wear.

The short pieces could be tested in various ways either at the outset or after the track-test was complete. An etching of a planed section would show roughly the part of the ingot from which that part of the rail was rolled, and there would also be the opportunity for making tensile and torsion-tests with specimens prepared from the head, web, and flanges, and chemical analyses from the specimens themselves at their point of fracture, which would give us some right to compare physical properties with chemical composition.

The following chart will help to illustrate some of the points I have indicated. It is intended to show in a graphic way, first the evils or faults in steel rails which are to be avoided; secondly, the causes which are accountable for these evils.

The circles on the left indicate roughly by their magnitude the relative importance of the various evils named. To express this estimate, diameters of 10, 7, 8, 6, 9, 7, and 12 respectively have been taken (the unit on the actual scale being one-sixteenth of an inch), and the corresponding areas, given in thousandths of a square inch, indicate the estimated relative importance of the respective evils. (Of the justice of this estimate, others must form their own opinions.) The lines connecting the two columns of circles indicate the causes which may produce such evil; and the magnitude of the right-hand circles, representing the relative importance of the "causes," is so calculated that the area of each cause-circle is the sum of the areas of the evil-circles with which it is connected. The most important causes to be avoided in manufacture are thus seen to be those which may produce the greatest number of occasions of failure, and the importance of the causes is proportional, on the assumptions made, to the areas of the right-hand circles.

*The only way to compensate for the loss of time resulting from reducing the speed of rolls, even to one-fourth of the present speed, would be to decrease the number of passes; for instance, doing in 5 or 6 what is more commonly done in 10 or 12.

The Croton Storage Reservoirs and Their Effect on Property.

[Contributed to ENGINEERING NEWS.]

The Croton system may be classed with those projects that require the accumulation of water, in distinction from systems of pumping from rivers or large lakes. The limitation of supply in such a case is obviously the reservoir capacity of the drainage area. To carry out any such system the acquisition of more or less territory is necessary, and herein is involved a wide diversity of rights.

When any benefit arises to a community by virtue of privileges obtained under the mask of public necessity, we are apt to hear fully of the obligation that the people at large are brought under. If a community suffers from the exercise of functions so bestowed, it remains passive, and degenerates without making an effort for redress. Possibly something of this nature is transpiring in the Croton valley.

Owing to the rapid growth of New York city, the volume of water needed will soon reach the maximum supply of the Croton basin, which is little more than 250,000,000 galls. daily. At the time this will come to pass (1897), there will be eight months of the year in which there will be no flow-off or waste, and the volume of water that escapes during the other four months will constitute 7 per cent. of the annual rainfall, the difference between this percentage and the draught of the aqueduct being accounted for by evaporation, percolation, and local draught.

Such a complete gathering and diversion of the water might reasonably be expected to change the aspect of a drainage basin as well as to alter its prospects for settlement. Already the work accomplished and in anticipation has manifested a measurable influence.

To ascertain this, it is only necessary to compare the growth of the Croton valley with the suburban region of New York which corresponds with it. Taking the north and south boundaries of the valley as limits, and describing two circles with Central Park as a center, we inclose 84 townships in New Jersey, 21 in Connecticut, and 37 in New York; 13 of these latter comprise the Croton basin.

The statistics concerning this belt of country show that Connecticut has secured more of the emigration from the city proportionally than New Jersey and both of these States more than New York. They also show that the Croton basin has received less population relatively than the balance of the belt section in New York State. So far as the

valley itself is concerned, the part of it confined to Westchester county displays an actual loss.

In 1880 the assessed valuation of the whole Croton basin was $15,000,000. Assuming that the same region was as densely populated as the 84 townships of New Jersey, the valuation would then have been $19,000,000. Assuming that the density was equal to that of the townships adjoining on the west in New York, the assessed valuation would then have been $36,000,000; and if it equaled that of the Connecticut townships adjoining on the east, the assessed valuation would then have been $42,000,000.

It is not admitted that the Croton valley lacks the advantages and inducements offered throughout this area of 4,500 sq. miles with which it compares so unfavorably in development. There is nothing so disparaging in its soil or climate as to justify the belief that if left to its own resources it would rank below all sections of the region named.

The glory or the shame of changing the character of this beautiful valley is undoubtedly due to the calculation 1,400 people and an accompanying valuation of $7,500,000.

Wherein is the New York public benefited? Is a law constitutional that stops the growth of the State?

A Big Blast.

The two engravings herewith are reproduced from photographs taken at a quarry in the town of South Bethlehem, N. Y., a few miles below Albany, and show the work done by a large blast which was exploded there at 6.30 P. M., Sept. 2. The blast is notable, not so much for its absolute magnitude, which has often been exceeded in blasts made by tunnels or drifts, but not often if ever by a blast made only by a series of ordinary drill-holes.

The rock is an arm of the Helderberg mountains, and is an extremely hard, tenacious formation. The carbonate of lime in the stone is over 90 per cent., and the excavation of the rock is, therefore, more or less difficult.

The rock is especially suited for road making, and the owner of the quarry, Mr. P. CALLANAN, is obliged to work his forces day and night. The stone crusher, run in connection with the quarry, turns out 100 tons per day.

It was recently decided, in view of the large and steady demand upon the quarry, to put in a blast heavier than any yet tried there, and blow down the whole face of the cliff at one explosion. It was calculated that the blast would displace at least 20,000 tons of rock. The steam drills were put at work and 50 holes were bored to a depth of 30 ft. These were charged with about 40 lbs. of dynamite each, a total charge of 1,950 lbs. The holes extended along the ledge for a distance of 350 ft.

The news of the approaching blast spread to Albany and other neighboring towns, and the West Shore Railroad ran special excursion trains to carry people to witness the event. On the afternoon of Sept. 2, about 3,000 people, among whom were many prominent engineers, gathered on the surrounding bluffs to watch the proceedings from a safe distance.

At 6.30 o'clock the electric circuit was closed and the explosion took place. The whole face of the cliff, as shown by our engraving, was thrown down, breaking it into pieces from the size of a freight car down. The amount of rock displaced by this blast is estimated at from 20,000 to 25,000 tons. Although the crushing plant is quite near the face of the work, no damage was done, the rock being so tough that the force of the explosion was spent in breaking it up, and there were consequently very few flying fragments.

The owner of the quarry states the blast to be the largest open-air blast in amount of material displaced ever fired in this country. We are rather inclined to doubt the accuracy of this statement, although a hurried search has not shown us any records of larger blasts in this country, with the exception of submarine work. Of course, in comparison with the Hell Gate blast in 1876 and the Flood Rock in 1885, this blast is insignificant. At the Flood Rock explosion, 240,000 lbs. of rack-a-rock and 40,000 lbs. of dynamite were fired, by far the greatest quantity of explosive ever used in one blast; and about 400,000 tons of rock were broken up.

A Blast with 1,950 lbs. of Dynamite at South Bethlehem, N. Y.

In England, however, there have been several open-air blasts far greater than the one illustrated in our engraving. In 1843 the Round-Down cliff, a chalk precipice 375 ft. in height, near Dover, England, was blown down with gunpowder to form a passage for the Southeastern Railway. In this charge 18,000 lbs. of gunpowder were used, which was placed in 3 chambers, located from 56 to 72 ft. from the face of the cliff. The quantity of rock displaced by this explosion was estimated at 400,000 tons, or over 22 tons per lb. of powder.

In 1850 a chalk cliff about 200 ft. high, near Sea-

ford, on the coast of Sussex, was thrown down by the explosion of 24,000 lbs. of powder, and 292,000 tons of rock were dislodged.

At Holyhead in 1850, a hard quartzose schist cliff was thrown down by 12,000 lbs. of gunpowder. About 40,000 tons of rock were dislodged, which was used for the harbor works at that point. In January, 1867, another blast was fired at the same place in which 16,000 lbs. of powder dislodged 120,000 tons of rock.

So much depends on the character of the rock, the placing of the charges, the cost of drilling, explosives, etc., that it is difficult to say just how good a record the blast illustrated in our engravings really made, in point of economy. This much is quite certain, however, that where circumstances are favorable, the explosion of large charges properly placed is the cheapest method of breaking rock from the ledge. At the quarry is an extensive plant for crushing and screening the stone; the stone being run on small dump cars to the machine

View of the Quarry before the Explosion.

and discharged direct from the crusher into the railway cars. With the advent of the era when our common roads are to be made of stone instead of dirt, and our railways are to be ballasted with broken stone, such large and conveniently arranged plants for furnishing the material as that here illustrated will become more and more common.

The Denver, Colorado Canon & Pacific Railroad Project.

BY ROBERT B. STANTON, CHIEF ENGINEER, D. C. C. & P. R. R.

[WITH INSET.]

It is with a good deal of reluctance that I ask space in your journal for a short article upon the cañons of the Colorado river. I feel this reluctance from the fact that my work of exploring these cañons *for railway purposes* is but half done; and I hardly have a right to express an opinion upon the whole route until this work is completed. But my feelings of reverence for the memory of one of my best friends, and gratitude for the many kindnesses received by me, from our late President, Mr. FRANK M. BROWN, compels me not to allow certain statements that have recently appeared in the press to go unanswered even though, of certain portions of the cañons, I can only speak from the testimony of others.

I have just been shown a copy of the Sunday issue of the New York *Tribune* of Aug. 18, in which appeared an interview with Major J. W. POWELL, as telegraphed from Washington, where are found the following statements by him:

When asked why BROWN failed, Major POWELL answered: "For the same reason, I think, that other parties have always failed. He underestimated the perils to be encountered. The Colorado Cañon, to speak of many cañons as one, is unique. There is nothing else like it in the world; none but itself can be its parallel, and so it is difficult for the imagination to foresee and appreciate its furious whirlpools, dangerous rapids, and tremendous abysses. I think that BROWN failed to comprehend the significant fact that nothing can get through the Colorado cañon that cannot float. Boats are repeatedly upset and inferior boats are smashed like eggshells. I knew Mr. BROWN somewhat. Last winter I received letters from various persons interested in locating a railroad route down the Colorado river. It was believed that a water grade for a railroad could be found, and that thus the vast coal fields of Utah and Colorado could be connected with tide-water in the Gulf of California,—a most desirable thing to accomplish. The president of the Denver Company, Mr. BROWN, finally visited Washington and called upon me, and made inquiries about the best method of making the survey. He seemed courageous and judicious, but in my judgment the plan was quite impracticable, and I told him so, and fully stated to him my reasons for such a conclusion. The reasons cannot be repeated in limits more brief than a magazine article furnishes. But I can outline them in a word. No railroad can run along the rocks at the top of the cañon, because the whole region is a labyrinth of stupendous lateral gorges from half a mile to a mile deep, and running back from the Colorado for many miles on both sides, and no engineering known to man can bridge them. In the main cañon the river often rises 40 to 60 ft., so that the roadbed would have to hang upon the sides of the cliff, which much of the way is perpendicular. The floods here surpass in size and suddenness any others on the globe. Mr. BROWN'S party was not overwhelmed in the most difficult part of the descent, by any means. He had just begun to encounter the real difficulties when he met with disaster in Marble cañon. It is a bad place, but he had not yet reached the most dangerous portion of the river. He had descended less than 600 ft., while the fall of the Colorado below was more than 2,000 ft."

"Was his boat a suitable one?"

"I would not have gone in it by any means. I was anxious about it even before he started. It did not seem to me adapted to cañon waters, it seemed too flat-bottomed, and must have been at the mercy of the swirling currents."

Major Powell was asked about the stories that various parties had succeeded in descending the Grand cañon at different times, and answered:

"Nobody has ever successfully traversed the Colorado cañon but my parties. The story that a raft once lived to get through is preposterous and was long since exploded. Invariably all attempts have been suspended or have met with disaster. The boat to go down the Colorado cañon must be sturdily built on a pattern which experience has proved the strongest, and should have three air-tight compartments; the men should wear life-preservers at all places of danger; and all tools, clothing and rations should be carried in air-tight ocean mail sacks, so that they will float. If these conditions are fulfilled, if the boats are tough enough, and the men at once plucky, intelligent, and prudent enough, and at the maximum of their health and strength, the cañon may yet be run again."

I could not forbear, saying, "You do not seem to have been quite up to this mark, for you first attacked the cañon long after you had lost an arm at Shiloh."

Major POWELL smiled whimsically, and said, "I was lucky."

It is not my purpose at this time to enter into any discussion of the railway route along the Colorado river in its various phases, with reference to its commercial or financial value, its local business, the resources of the country through which it passes, or its many advantages as to grade, alignment, distance, etc.; nor shall I attempt any extended or finished description of the river and its cañons. When I have completed our explorations and preliminary surveys, I may find time to enter into these subjects.

To Major Powell belongs all the glory and renown possible for his *first* trip through the unknown canons of this wonderful river. Starting as he did without the slightest knowledge of what was before him, with the possibility of a greater than Niagara awaiting to swallow him and his little band at any turn in the river, required a bravery and nerve far greater than it now does to follow in his footsteps. I have a very much greater admiration for his bravery and determination, and that of his little band, since I have traversed a portion of their route

and seen something of the hardships and dangers they had to undergo, and no one is more ready to render homage to the gallant soldier and his followers than myself. It is therefore with feelings of regret that I am compelled to answer some of the damaging and misleading statements made by Major POWELL and other government engineers, which, from the very position of these gentlemen, cast reflections upon the memory of our late President, Mr. BROWN, and point ridicule at the practicability and possibility, from an engineering standpoint, of constructing a railway through the cañons of this remarkable river.

Before our survey commenced, all such statements covered the whole river, from its head to the Grand Wash; no exceptions were made. [The Grand Wash is at the lower end of the Grand cañon, about 35 miles above the mouth of the Virgin river.]

In addition to the above quoted interview, I have before me a letter from Major Powell under date of April 9, 1889, in which he says:

"Fig. 29. Granite Walls" (of Grand Canon.)
[Reproduced from Major POWELL's Report of his Exploration of the Colorado Cañons in 1869.]

"While not wishing to discourage the promoters of the railroad project of which you write, I venture to suggest that it is an undertaking fraught with difficulties of great magnitude; in fact, it is impracticable, but upon this subject my views have not been asked."

Let us look for a few moments at the nature of that portion of the route over which our survey has been made. From the head of the Colorado, for 41 miles through Cataract cañon, a railway can be built on easy slopes and long flats, with no cliff work at all. The three photographs I send you illustrate this,—No. 52 some of the worst, No. 57 the average, and No. 47 the best class of work in this cañon.

Through Narrow cañon, a distance of 9 miles, the rock is harder, and the slopes of the cañon formed in benches are more precipitous. Photograph No. 110 shows some of its worst features, while the whole line can be located on these benches without at any point, "hanging upon the sides of the cliff." In this distance of 50 miles, there are large flats and bottom lands, aggregating some 6 miles, besides country broken back into gentle slopes.

This brings us to the mouth of the Dirty Devil river. From this point to the mouth of the Pariah creek (Lee's ferry), a distance of about 155 miles, the river passes through Glen cañon. For the greater part of this distance our line is upon good slopes and long stretches of bottom land (see photograph No. 135) while some portion is at the bottom of cliffs (as shown in photograph No. 154), on the talus, or well-formed bottoms, with some few miles to be built in the wide portions of the river itself; but in no place is it necessary "to hang it upon the sides of these cliffs."

For the last 40 miles of Glen cañon, the river is very tortuous, and to locate a good line would require some 15 tunnels, mostly short, from 300 ft. up, with two perhaps 1 mile in length each. But the extent of this tunneling, aggregating some 3½ miles, is quickly offset by the fact that in Glen cañon there would be some 30, and perhaps 40, miles of plow and scraper work, with banks from 2 to 5 ft. high, and tangents 3 to 5 miles in length.

Marble cañon as far as I have gone presents no insurmountable difficulties to railway construction. The whole cañon is benched back, as shown in photograph No. 189, except at points which from the nature of the case would be tunneled; hence, taking into consideration that portion on Grand river, we have some 400 miles of line through these "impassable" cañons, not only possible and practicable to build a railroad upon, but much more easy and cheap to construct than many large portions of such roads as the Cincinnati Southern Railway, the Denver & Rio Grande, or the Colorado Midland, with possible maximum grades of 16 ft. per mile, and economical ones not to exceed 26 ft. per mile, and curves possibly not to exceed 6°, with bottom lands and flats large enough for great towns and even for farms, were they not so valuable as placer mines, and not one hundred feet "where it is necessary to hang our road on the sides of the perpendicular cliffs."

Let us look for a moment at Major POWELL'S description of this portion of the river. After reading his beautifully written and fascinating book, descriptive of his journey in 1869, the only impression left upon one's mind is of great cataracts, roaring rivers, and perpendicular cliffs; and I must say that, with this as our guide, I went into the work with many misgivings as to the possibility of our being able to make even an instrumental survey through some portions, even of Cataract cañon. I shall take only a few examples of his description and compare them with what we actually found.

Page 62.—Our way after dinner is through a gorge grand beyond description. The walls are nearly vertical.

See our photographs of Cataract cañon for answer to this.

Page 63.—The walls of the cañon are more than 2,000 ft. high; in many places they are vertical from the water's edge.

In no place are the walls 2,000 ft. vertical from the water's edge.

Page 67.—The cañon is very tortuous, so that we can see but a few hundred feet ahead, the walls tower over us, often overhanging, so as to almost shut out the light.

The facts in the case are these: there is not a stretch of river one half mile in length where the direct rays of the sun do not shine on nine-tenths of the water at some time in the day, and at that portion of the cañon which he is here describing, the cliffs do not overhang more than 10 to 15 ft., and are only from 50 to 100 ft. high, while the whole cañon itself is about 1,800 ft. deep and the walls at the top are from 3,500 ft. to one mile apart, rather a difficult place, I should think, "to shut out the light."

Page 62.—We are compelled to make three portages in succession, the distance being three-fourths of a mile, with a fall of 75 ft.

No such fall exists in Cataract cañon. The greatest fall at any one point is 55 ft., and this is stretched over a distance of two miles.

With such statements as these written at the time, and with their images growing darker, taller, and grander for twenty years, and with no one having traveled these waters since to test the accuracy of the descriptions, I can well understand how easy it has been to erect these imaginary perpendicular walls towering almost to heaven, and to hang an imaginary railway thousands of feet above the water, upon imaginary brackets or some other imaginary device, and then pronounce the road both impracticable and impossible.

Just here it may be remarked further that any one can walk down in the cañon from the head of the Colorado, 55 miles, to Dandy Crossing, and perhaps 100 miles further, without getting his feet wet, and never go outside of the cañon, and at no point go on any bench of its sides more than 300 ft. above the water of the river; and again, in the upper part of Marble cañon at one point, in order to locate the best railroad line, it will be necessary to change the channel of the Colorado river and build an embankment in the old bed. It seems presumption on my part to make such a statement when the portion of the cañon referred to is thus described by Major POWELL: "The cañon is narrow, with vertical walls which gradually grow higher." But it can be easily and cheaply done. We have not only our observations and instrumental notes to substantiate what I here say, but nearly 200 photographs, giving almost a continuous panorama of the river from its head to the middle of Marble cañon.

Let us now take up that portion of the cañon that I have not yet traversed, viz., 230 out of 630 miles.

It is a noticeable fact, as stated above, that at first all the statements made by Major POWELL and other government engineers, as to the impracticability and impossibility of building a railway down the cañons of the Colorado river, covered the whole river from its head to the Grand wash; no exceptions were made. It is also a noticeable fact that since an actual instrumental survey for a railway has been made, over some 400 miles, including that portion on the Grand river, these same statements, by these same gentlemen, as to the impracticability and the impossibility of the route, are now confined to that portion of the Marble and Grand cañons through which we have not as yet carried our line. This reminds me of an experience years ago on the preliminary surveys of the Cincinnati Southern Railway through Kentucky and Tennessee. We went into Kentucky at a time when there were many reports as to the prevalance of milk sickness. Whenever we came to a farmhouse we inquired, before we would drink any milk, as to the reported disease. Of course, there was none on their farm, but a few miles ahead they told us we must be careful, as all the cows were affected. We chased that milk sickness through the whole States of Kentucky and Tennessee, and drove it into the hills of northern Georgia, but we were never able to overtake it; it was always in the next county ahead.

Of course, we always expected our greatest difficulty in the marble and granite formations. I have traversed about one-half of Marble cañon, and find no difficulty for a railway of any moment to a competent engineer, nor any work that would in any degree appal the financial agent of the company.

For the remainder of the distance I take Major POWELL'S description of his voyage in 1869, and his more recent topographical maps, together with Captain DUTTON'S geological maps and his very complete work on the geology of this Grand cañon district.

I first take up and re-read Major POWELL'S chapter on the Grand cañon, and as I complete it, I lean back in my chair and close my eyes; my brain is in a whirl, and I do not find it in the least "difficult for my imagination to foresee and appreciate its furious whirlpools, dangerous rapids, and tremendous abysses" and its "walls now more than a mile in height," and to see that same imaginary railway on those same imaginary brackets, thousands of feet above my head.

As I rub my eyes and open them again to the light, I come to the conclusion that it will only be best to give this description, in so far as it bears upon the possibilities of railway construction, the same weight that I am now compelled from personal examination to give the description of that portion from the head of the river to the middle of Marble cañon.

Turning now to the latest government topograph-

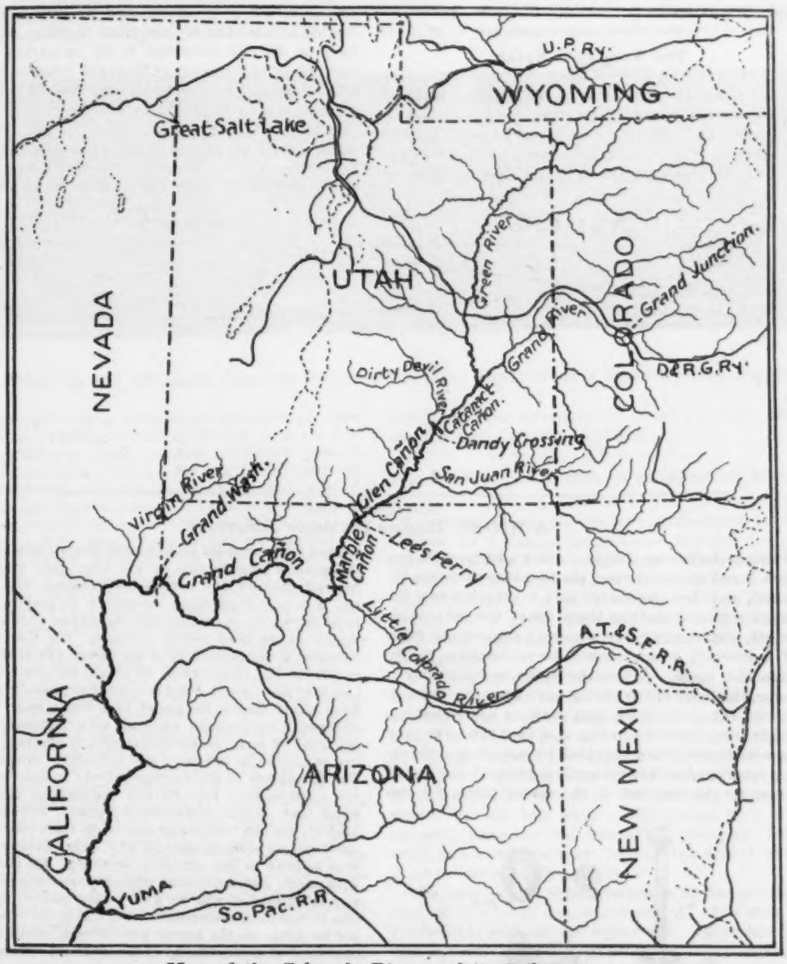
ical maps, I find that by their evidence, the slopes of the cañon in the section from the Little Colorado to the Grand wash are more flat; that the first contour lies further back from the water, the gorge itself is wider at the bottom, and the detailed course of the river is much more direct than in that portion of Marble cañon over which I have been and found but few railway difficulties.

Returning to Major POWELL'S book, and opening at page 86, I find an engraving entitled, "Granite Walls." (Reproduced herewith.) We certainly have a right to conclude that, with his graphic description of the towering granite walls and overhanging cliffs, when he should come to illustrate them, it would be but natural to reproduce the most towering perpendicular walls the cañon affords. "Look at that (word) picture and then at this," and any one acquainted with the Rocky Mountain region will say that every railway in the mountains of Colorado runs every day over sections of country vastly more difficult than this picture represents.

I copy the following from Captain DUTTON'S book on the Grand cañon district, page 143:

> The common notion of a cañon is that of a deep, narrow gash in the earth, with nearly vertical walls, like a great and neatly cut trench. There are hundreds of chasms in the plateau country which answer very well to this notion. It is perhaps, in some respects, unfortunate that the stupendous pathway of the Colorado river through the Kaibabs was ever called a cañon, for the name identifies it with the baser conception.
>
> From the end of Point Sublime, the distance across the chasm to the nearest point in the summit of the opposite walls is about 7 miles. . . .
>
> A more correct statement of the general width would be from 11 to 12 miles. This must dispose at once of the idea that the chasm is a narrow gorge of immense depth and simple form. It is somewhat unfortunate that there is a prevalent idea that in some way an essential part of the grandeur of the Grand cañon is the narrowness of its pefile. . . .
>
> Nowhere in the Kaibab section is any such extreme narrowness observable, and even in the Uinkaret section the width of the great inner gorge is a little greater than the depth.

It is not my purpose to belittle in any way the difficulty, the grandeur, or the dangers of the Grand cañon; but it would be useless to take up your space in the vain attempt to improve upon the beautiful and glowing descriptions of Capt. DUTTON, or to make more vivid the word pictures by Major POWELL of its furious whirlpools, dangerous rapids, and thundering cataracts. It is, however, of small consequence, so far as a railway is concerned, that we had descended only 975 ft. in altitude from the head of the river to the point where we left it, and still have 1,825 ft. to fall to the Grand Wash. Nor is it of any importance whatever in this respect if in this distance there are individual falls of 30 or 40 ft. The question is: Is it a practicable railway route?



Map of the Colorado River and its Tributaries.

After studying this carefully, I have come to a conclusion expressed some time ago: That with our railway line, such as it is from Grand Junction to the point where we left the river, a distance of 400 miles, and with the knowledge every one has of the character of the river country from the Grand Wash to the Gulf of California, a distance of some 575 miles, and with all the information I can gather of the character of the cañon for 230 miles between these points, even though I as yet know nothing from personal examination as to the character of the Grand cañon, it is my opinion that it is utterly impossible to crowd into this section enough difficulties to condemn the route for an easy and comparatively cheap railway, taken as a whole; and if the following table, copied from Major POWELL, is correct, I see no reason why we cannot maintain an economical maximum grade of 26 ft. per mile.

	Distance in miles.	Total Fall in feet.	Fall per mile.
Marble Cañon	65.2	510	7.82
From Little Colo. to Kaibab Div.	9.6	60	6.25
Kaibab Division	58	700	12.07
Kanab Division	47.6	240	5.01
Uinkaret Division	19.6	100	5.21
Sheavwits Division	84	540	6.43
Total	283.6	2,150	7.56

Pardon me if I still further encroach upon your space in answering a few of the minor points in the above quoted interview. No sane man who had ever seen any portion of the Grand cañon district, or studied a topographical map of it, would ever let enter his mind the idea of looking for a railway route "along the rocks at the top of the cañon;" yet I am not prepared to say that there is "no engineering known to man" that could not bridge these side cañons upon a properly located route running through the country parallel to the course of the Colorado river.

However, bridging these side cañons at their highest and widest parts is very different from bridging them at or near their mouths. It may seem strange that many if not all of these side cañons, especially those in the Marble and Granite cañons, are much narrower at their mouths than further towards their heads, but this is the fact, as is also shown by the government reports above quoted. The widest of those over which we have passed can be bridged with a 200-ft. span, except the San Juan river, and that, though it passes at one point in its course through a cañon 1,500 ft. deep and from a mile to a mile and a half in width, can be bridged at its mouth with a 450-ft. span, only 40 ft. above low water. (See photograph No. 145.) Some of these side canons that I have traversed, while they may be thousands of feet deep and miles wide further back from the river, can be bridged from marble cliff to marble cliff with from 50 to 80 ft. spans, so that these side gorges, crossed at the proper places, present but little difficulty to modern bridge engineering. Our contemplated line would cross the main river itself but once, and that in Marble cañon at a point where the marble cliffs come nearest together, and at a sharp bend just beyond Vasey's paradise. Our line, being on the left or east bank along the upper part of the river, after crossing at the above point, will undoubtedly remain on the right or west bank the remainder of the distance.

The question of floods and high-water mark is easily disposed of by a simple geological fact: wherever the cañon is narrowed up, as in portions of Marble cañon, and the high-water mark is 40 to 85 ft. above low water, the first broad bench on which a road would be built is, by the very nature of the case, from 50 to 100 ft. high.

Major POWELL pronounces President BROWN'S boats unfit for such waters. On what does he base his opinion? Did he not make his first trip through the cañon in a boat but two feet longer than the one President BROWN was in? Were his boats more "sturdily built" than ours?

Up to the point where we left the river, he had four boats capsized, we had three; he had one boat completely smashed, so had we; and comparing his record with ours, I find he had to stop and repair his boats and make oars much more frequently than did we. Our boats were keel-bottom boats, and not flat-bottomed. They each had air-tight compartments, and in no instance did one of our boats sink. The shape or stability of our boats had nothing to do with Mr. BROWN'S death or the "failure" of his expedition. Our one weak point is the one that Major POWELL refers to in his last paragraph, and which he here mentions for the first time, as far as I can learn, for twenty years, and that is life-preservers. In all of Major POWELL'S expeditions on that river, he and all of his men were provided with life-preservers, and when his boats were repeatedly upset, he and his men's lives were saved by these life-preservers.

In the published official accounts of his expeditions of 1869-70-71-72, there can nowhere be found one word mentioning life-preservers. He describes the boats, tools, instruments, supplies, and even the amount of whiskey that was taken, but nowhere describes the life-preserver. Why this omission from his book?

Last May, President BROWN called on Major POWELL in Washington, and spent some hours in

talking over his proposed trip. Major POWELL questioned and criticised the projected journey, the boats, the water, provisions, etc. Did he at that time explain the necessity of life-preservers?

When President BROWN returned to Denver, he was urged by his friends to provide himself and party with life-preservers. His answer was, "It is not necessary. Major POWELL never used any, and he says swimming in that river is very easy; it is not necessary to be burdened with them."

Let me quote a few lines from the Major's book, on which Mr. BROWN based his opinion:

Page 48.—Another wave rolls our boat over, I am thrown some distance into the water, I soon find swimming is very easy and I cannot sink. It is only necessary to ply strokes sufficient to keep my head out of the water though now and then, when a breaker rolls over me, I close my mouth and am carried through it."

Page 102.—RHOADES, HALL, and myself run to the other boat, jump aboard, push out, and away we go over the falls. A great wave strikes us, the boat rolls over and tumbles and tosses I know not how. All that I know is that BRADLEY is picking us up.

Such descriptions as these are simply absurd to one who has traveled those waters, and seen three men drowned in comparatively smooth currents, except when the fact is known that Major POWELL and each of his men were provided with a huge life-preserver, and hence, they "cannot sink." Again I ask, why this omission from his book? And just here comes the sad thought that had not Mr. BROWN been too confident, and had he provided himself and party with proper life-preservers, he and his two comrades would be living to-day, for every other provision was made against danger. All three men were powerful swimmers. My boat was at the point where Mr. BROWN sank only about one-half minute after he was thrown into the water, and so in the case of the other two men.

President BROWN had conceived a great project. His whole energy was given up to it. His only fault was in relying upon written statements which he believed were not only the truth, but the whole truth. President BROWN was a martyr to what will be in time a successful cause, and some day there will be built a monument to his name in one of the greatest railways of the continent, through the grandest gorge on the face of the globe; and as we and our children shall ride in safety and luxury through its many-colored amphitheaters, that most wonderful of rivers will sing, in the roar of its mighty waters, everlasting requiems to his memory.

ROBERT B. STANTON,
Chief Engineer.

RELATIVE SPEED PER SECOND.—According to the recent computation of a German scientist, a snail, in one second, moves .0015 metre; a man walking, 1.25 metres; a man on snowshoes, 2.95; the swiftest river, 4; a balloon in a calm, 6.4; a sprinter, 7.1; fly, 7.6; fast steamboat, 8.5; fresh breeze, 10; torpedo boat, 11.5; very fast skater, 11.6; running race horse, 12.6; mountain torrent, 14.3; express train, 16.7; ocean wave, 21.8; carrier pigeon, 27; swallow, 67 heavy cyclone, 116; sound, 337; an equatorial point' 463; cannon ball, 500. In a second the moon moves one kilometre; explosion of gun cotton, 5.8 kilometres; sun, 7.6; Sirius, 15.4; the earth, 29.5; shooting star on the average, 40; Halley's comet near the sun, 393; storm on the sun, 402; cable current, 4,000; telegraphic current, 11.690; induction current, 18,400; light, 300,000; discharge of Leyden jar on copper wire, 1.7 millimetres through, 463,500.

A CORRESPONDENT writes us from the Rock Island Arsenal:

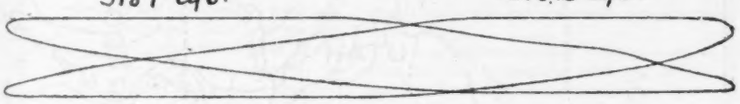
The work is to construct a dam for water power at the arsenal in the place of the one which was carried away last year, and which was built under the direction of Col. FLAGLER. The wheels (turbines) are set in the dam, and the power is transmitted to the arsenal shops by means of wire rope. The island itself is a bower of beauty. A more delightful place I never saw. It is about 2½ miles long, and perhaps a mile wide, laid out in beautified drives and walks, and not too much artificiality. One thing has struck me as rather a curious anomaly. This place is designed for the construction of everything murderous and wicked; per contra it is not permitted to shoot any animal on the island, and in consequence the squirrels and rabbits are very tame and show no fear.

A Hot Air Engine Indicator Diagram.

The accompanying cut, showing a sample indicator diagram from Woodbury, Merrill, Patten, & Woodbury's hot air engine, taken in Mr. GEO. H. BARRUS' tests, was received too late for insertion in connection with the detailed description of the engine in last week's issue. In its form the diagram is as different from a steam engine diagram as the motor itself and its principle of operation is different from the ordinary steam engine. By reference to the descriptive matter in our last issue, the nature of the diagram may be easily understood. It gives a very valuable representation of the actual working of the expanding and contracting air; and the directions in which the machine may be further developed, as briefly noted last week, are clearly indicated.

The Tripartite Spike.

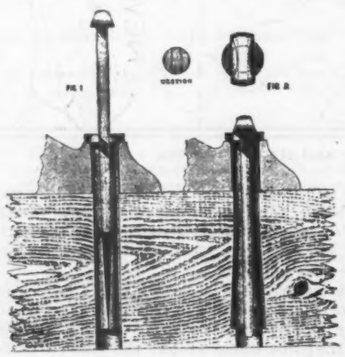
We illustrate herewith a novel English railway spike known as the "Tripartite," which we find illustrated and described in a recent issue of *The Engineer*. The illustration shows the spike as applied to an English railway chair. The application



Atmospheric Line.

A Hot-Air Engine Indicator Diagram.

of this spike is very simple. After a round hole has been bored in the sleeper, the two side parts are inserted, and then the center part is driven down between them, spreading them apart towards their points, and causing the whole to assume the form of a dovetail, which cannot be withdrawn bodily from the wood. When the spike is fully driven home, the head of the center part rests on the collars of the side pieces, and projects somewhat beyond them, as shown in Fig. 2, so that the spike may be withdrawn when required by applying a pinching lever under the projecting part of the head, when, by the removal of the center piece, the two



The Tripartite Spike.

side parts being left loose, can be readily withdrawn, and the hole in the wood sleeper left intact, so that the spike can be replaced, and will be as tight as before its removal.

The spike would need some remodelling, we apprehend, for use with the American rail, to secure a good bearing on the rail flange and to permit the two side pieces to be spread lengthwise of the grain of the tie to avoid the danger of splitting, and to secure the tightest possible fit. The use of a washer between the head of the spike and the rail-flange would make the spike usable in its present form.

The principle of this spike seems a valuable one for other uses. For drift bolts it would seem to be especially adapted. We are not informed as to the cost of the spike; but if made in quantities, it should not be very expensive. For ordinary use it might do as well to make the cross section square instead of circular, which would perhaps make its manufacture possible by a modified type of nail machine.

Some of these spikes are in use on the London & Northwestern Railway. They are made by the Patent Nut & Bolt Co., and are on exhibition at the aris Exposition.

Railways in China.

The question of the extension of railways in China is still a live issue, and we extract the following interesting article from the Shanghai *Mercury* of July 30, referring to an important memorial from the Governor of Kiangsu, proposing quite extensive construction by native rather than foreign capital, mainly for military purposes:

In to-day's native papers appears an important memorial on the question of railways generally in China by the Governor of this province. The writer, who has evidently studied the question to some extent, may be ranked with the other high Chinese officials who advocate the general introduction of the iron horse into China for both military and commercial reasons. The memorial is a very formidable document in length, and we must therefore, in dealing with it, confine ourselves to a sketch of its most salient features. The Governor of Kiangsu, it would seem from his utterances, is driven to recognize the importance of China following the example of all other civilized countries, principally because he is afraid that in the grand race China may be outstripped, if she does not keep up with the times, and be deprived of some of her territories, if she lags behind her neighbors in offensive and defensive preparations. The operations of the Russian railway constructors on her northwestern frontier, and the fears of aggression when that power completes the grand trans-Siberian project, are put forward by him at an early stage of his memorial as pressing reasons why China should have a long railway in her northern territory. He points out with truth and force that when the trans-Siberian railway is finished it will be a very easy matter for Russian troops to be transported from one point to another, and he instances the Amoor provinces as parts then in vital need of protection by China, if China wishes to retain them. He is in favor of a main line from Tientsin to Shan-hai-kwan, which is exactly what all strategists who have given China gratuitious advice have advocated, particularly the ingenuous and disinterested strategist who presides over our Tientsin contemporary. He also advises an extension from this line to Hei-lung-kiang, or the Amoor region, with branch lines to Kirin and Ning-ka-ta. This portion of the railway system, the construction of which he recommends is, we take it, more with a view to strategic advantages than commercial results, for in reference to it he again reverts to the immense facilities which China's northern neighbor has now, and will shortly possess in even a greater degree, for the massing of troops in double-quick time wherever she may require them in northeastern Asia. In fact, the dread of the Russian bear once immortalized in Skibbereen has taken possession of the Governor at Soochow.

The advantages of tapping the vast but almost unknown resources of the distant provinces of Yunnan and Kansuh are pointed out, and the Governor thinks a railway should be run through these regions. He also advises the construction of a branch line to Kuldja. He further recommends the ultimate extension of the line in a southwesterly direction to Kashgar. He then proceeds to speak of the importance of being able to transport troops quickly into these regions, and dilates upon the advantage which it would be to have a new field to which the people could be sent from the

more congested provinces, by which their own position would be improved, and by the cultivation of large tracts, at present unproductive, the country rendered so much richer. He refers, as a proof of the commercial advantages which a widespread railway system would insure, to the richness of the copper and other mines of Yunnan and Kwangsi, which are now almost undeveloped, and which he says would give a valuable return if a means of sending them to a market were at hand. He also points to the importance of improving the means of communication between the capital, Peking, and the southern provinces, and states that every day the present route by creeks and canals is becoming more blocked up and insufficient, and he further thinks that a line along the Yangtze should be a matter for future consideration.

He gives a fairly correct history of railway development in other countries, mentioning that railways were first tried in England, where he says their general adoption was slow, and had to overcome prejudice. This, no doubt, is a sort of apology for the tardiness of China in the same direction. He again reverts to Russian railways, which he tells us correctly are Government undertakings, and points out that in France they are supported by subsidies from the State. He then passes on to the rapid strides of the iron horse in Japan, which, he says, along with another insignificant country, Turkey, is far before China in means of rapid communication. He then touches upon the very practical point as to how China is to raise the pecuniary wherewithal for these enterprises. He introduces it with a neat little fling at the grasping of foreign financiers in exacting 8 or 10 per cent. from China for loans, whereas they could only get 3 per cent. at home. He thinks that this alone should cause China to pause before she resorts to foreign capital to build her railways. He strongly advocates that they should be constructed with native capital, of which he thinks there is sufficient to carry out the work by degrees. He thinks that this money could be obtained in the country, and that native capitalists would subscribe to railway enterprise is shown by the liberality of the support which they have given to the China Merchants' Steam Navigation Co. He further urges, as an argument in favor of the adoption of railways, that the Chinese were at first opposed to steamers and telegraphs, which have now been firmly established, and with great and important advantages to the country.

In concluding his memorial he adds that he was not in favor of telegraphs, railways, and steamers when he was an official in Peking, but after coming out of the capital he has found that the construction of railways is of urgent importance.

In the spring of the present year orders were sent from Peking to several of the provincial governors to report upon the propositions for the construction of railways, and these reports are now being sent in. The Viceroy of Canton says that railways are becoming a necessity for purposes of defense. It has been claimed by its opponents that the line from Tientsin to Tungchow would result in the spread of foreign religions, the exposure of the capital to invasion, and the employment of foreign labor and materials to the detriment of native interests. The introduction of steamers and telegraphs, however, has not been attended by much spread of foreign religions. The Viceroy believes, indeed, that the same prudence which made England veto the Channel Tunnel should make China veto the Tientsin-Tungchow Railway, unless she is prepared to spend a large sum in special defensive preparations. The number of men employed in cart and boat traffic between Tientsin and Tungchow is about 60,000, and allowing to each a family of five, that makes a total of 300,000 persons depending on this trade.

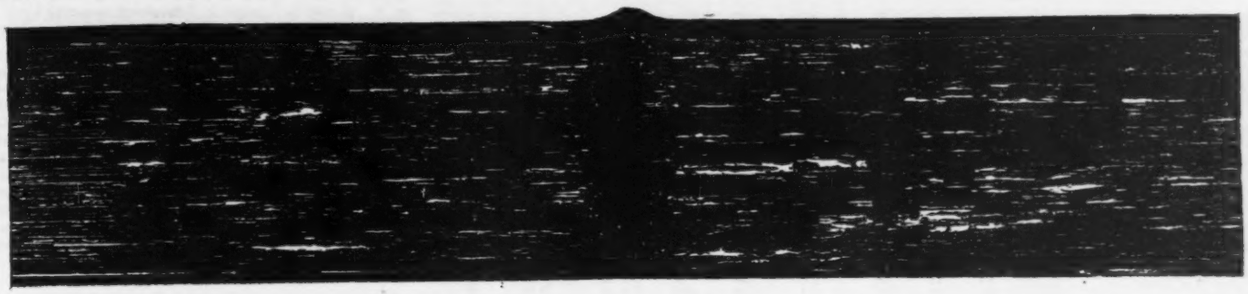
The Viceroy CHANG thinks this estimate probably not excessive, and believes that at least half of them would be thrown out of employment by the introduction of the railway, while the latter would employ only about 800 men in its operation. A proposal has been made for a railway along the old bed of the Yellow river, passing through Tēh-chow and Tsining Chow in Shantung. But the drifting sand of this country would be a bad foundation, and repairs would be continually needed, causing a ruinous expense. The best place to build the first great railway would be starting from Luk'-ow K'iao outside Peking, to Honan, and on to Hankow in Hupeh, about 666 miles. This would be too far removed from the coast to cause apprehension of its being seized and utilized by an enemy; and this line would not necessitate the removal of many houses or graves to allow it to pass. It would cost about $18,000,000, and the construction would extend through 8 years. Iron quite good enough for the purpose could be obtained from the P'ingting mines in Shansi, and although this would cost more and be inferior to foreign iron, yet the employment of it would give the advantage of China's money being spent in China instead of abroad.

Abating the Nuisance from Asphalt Works

The nuisance from melting asphaltum, which has been supposed to be necessary in connection with the manufacture of asphalt pavement, has been done away with by the Barber Asphalt Paving Co., at their Buffalo works. The old style of working the asphalt and mixing it with sand produced a cloud of disagreeable odors and flying dust and soot, and the nuisance was almost unbearable. One citizen brought suit against the company for $10,000 damages, but the jury disagreed on the first trial. A few months ago Mr. A. L. BARBER, president of the company, was indicted for maintaining a nuisance. Plans were then put under way for obviating the nuisance. The building where the asphalt is melted, is now almost entirely inclosed, and large fans convey the offensive vapors to a furnace where they are consumed. In the melting-room the fan shell is 6 ft. in diameter, with a 28-in. opening and discharge. Near by, where the boiling asphalt is mixed with sand, a great improvement has been effected. Heretofore the cloud of dust emanating from the mixing-room was the cause of many complaints.

The improvement adopted is simple, consisting of a hood over the mixer, the shell being 5 ft. in diameter, with a 24-in. inlet and discharge. The fan in the melting-room makes 1,100 revolutions per minute, and the one over the mixer revolves 1,200 times per minute. The vapors are conveyed to a furnace specially constructed to burn them. The fuel used is crude petroleum, and the smoke given off is almost indiscernible, and is said to be entirely free from offensive-smelling gases. The cost of the fans and smoke-consumer was about $3,000.

If some ingenious inventor will now devise a smoke-consumer to attach to the portable furnaces in which the asphalt is melted for laying, and will induce the asphalt companies to adopt it, another boon will be conferred on people gifted with the sense of smell.



A Weld by the Thomson Electric Welding Process; Print from a Butt-Welded Bar treated with Acid to show Fibrous Structure.

The Fibrous Structure of an Electric Weld.

It is very seldom that we have to apologize to our readers for a ruined engraving; but our cut on page 260 of the last issue, owing to the combined blunders of the engraver and pressman, resembled a topographical map of a section of the Dismal Swamp much more accurately than it did the fibrous structure of the iron bar from which it was photographed.

We have therefore remade the cut, as a positive instead of a negative, the black showing the smooth surface of the iron untouched by the acid, while the etched hollows appear in white. We trust that if any of our readers were so rash as to conclude that the electric welding process was able to twist the fibres of an iron bar in to the astonishing curves shown in our last week's illustration, they will carefully examine the engraving presented herewith and obtain a clear idea of the actual work done by the welding machine.

The bars welded were two pieces of flat wrought iron of ½ x 1 3-16 ins. cross-section. The burr at the weld is seen on the upper side, where the bar has not been planed or ground. The opposite side and the flat face from which the print is made were ground and planed and polished, and then etched with an acid solution. As seen by our engraving, the metal seems to have been refined and made more homogeneous for about 5-16 in. each way from the point of juncture. Only a few minute hollows are to be discerned in the specimen here, while on each side the bar shows the usual coarse fibrous structure of wrought-iron. The line of juncture, which on the specimen shows plainly at the outside of the burr, has disappeared entirely in the interior of the bar, and even the etching fails to show any weak spot or imperfect junction where the two pieces have been fused together.

For further description of this process we must refer our readers to the articles in our last and preceding issues.

ELECTRICITY IN THE UNITED STATES.—There are over 1,000,000 miles of telegraph wire, or enough to encircle the globe forty times.—It is estimated that 250,000 persons are engaged in business depending solely on electricity.—About 400 miles of electric railway are in operation, and much more is under construction.

THE EIFFEL TOWER.—We find the following astounding story concerning this structure in the Portland (Me.) *Transcript*, credited to *Paris Illustré*:

The whole tower could be lifted by 4 men of average strength. The case has been proved. When it was about half its present height, a few men actually did lift it. This is not humbug; the thing is perfectly simple. The construction of the tower is based on the cantilever principle, and its bulk of 6,400 tons is so adjusted as to press on the foundation with less weight than that of a man in an armchair on the floor.

It seems hardly likely that any Paris journal would perpetrate so stupendous a hoax as the above; but how any translator could make up so Munchausen-like a tale, in changing French to English, passes comprehension. When such statements are printed in reputable papers, and vouched for as facts, one wonders if this is not the Dark Ages, after all, instead of the nineteenth century. The sole foundation for this remarkable story is the fact that the four legs of the tower rest in four chambers into which water can be pumped to raise the leg by hydraulic pressure. An ancient philosopher once offered to move the earth if provided with a long enough and strong enough lever and a steady fulcrum; and the hydraulic ram embodies the same principle. It would be interesting to know what sort of an idea of "the cantilever principle" the writer of the above had; and whether he would be willing to have one of the legs of this 1,000-ft. structure (since it presses with less weight than that of a man in an armchair) rest for a moment on his own foot.

Elements of Weather in the United States of most Interest to Engineers, for the month of August, 1889.

STATIONS.	Temperature. Degrees Fah.				Wind velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average.	Max.	Direction at time of Max. Vel.	Total.	Heaviest in 24 hours.	No. rainy days
Northern Cities.										
Northfield, Vt.	61.3	83	40	43	6.0	28	S & W	1.59	0.33	14
Portland, Me.	64.6	81	47	34	5.9	28	E	2.76	1.06	9
New York City	71.5	90	56	34	8.2	25	W	3.39	0.97	10
Pittsburg, Pa.	70.2	89	50	39	3.9	20	SW	1.88	0.86	6
Chicago, Ill.	70.6	88	54	34	7.1	25	SW	0.39	0.16	7
Omaha, Neb.	73.9	92	56	36	7.0	30	S	2.90	1.60	7
St. Paul, Minn.	70.5	91	49	42	6.9	38	SW	3.56	1.90	5
Duluth, Minn.	64.8	86	48	38	6.1	27	NE	7.87	2.76	11
Bismarck, Dak.	70.3	102	44	58	8.4	41	NW	0.53	0.31	4
Average.	68.6	89.1	49.3	39.8	6.6	28.9		2.76	1.11	8.1
Southern Cities.										
Washington City.	72.0	90	55	35	5.0	36	NW	3.07	1.17	13
Louisville, Ky.	73.9	91	54	37	4.3	30	SW	0.23	0.11	3
St. Louis, Mo.	75.4	91	60	31	6.4	30	SW	0.85	0.64	4
Savannah, Ga.	77.8	99	64	35	4.7	38	NW	7.50	2.60	18
Leavenworth, Kan.	74.0	92	55	37	5.1	36	NW	7.09	3.38	11
Jacksonville, Fla.	79.7	94	64	30	5.5	25	NW	5.25	1.82	16
Chattanooga, Tenn.	74.9	91	57	34	3.5	25	E	3.77	1.11	18
New Orleans, La.	80.6	92	70	22	6.4	24	E	5.89	1.71	16
Memphis, Tenn.	77.3	92	62	30	4.3	37	N	5.62	2.33	7
Palestine, Tex.	82.0	91.5	72.0	19.5	3.8	30	N	1.77	0 94	9
Average.	76.2	91.4	60.1	31.3	5.0	31.2		4 33	1.65	11.8
Western Cities.										
Helena, Mont.	67.2	93	40	53	5.3	36	NW	0.31	0.30	2
Port Angeles, Wash.	55.2	70	42	28	4.9	24	W	1.58	0.72	6
San Francisco, Cal.	60.4	80	49	31	11.0	32	W	*T	*T	0
Salt Lake City, Utah	77.4	98	45	53	5.8	36	S	0.92	0.54	8
Denver, Col.	72.8	98	46	52	6.1	42	SW	0.33	0.25	5
Yuma, Ariz.	92.5	114	73	41	6.8	36	S	0.25	0.12	3
Santa Fé, N. Mex.	70.9	88	54	34	5.7	28	E	1.43	0.55	9
Average.	70.9	91.6	49.9	41.7	6.5	33.4		0.69	0.35	4.7

*T indicates trace of precipitation.

Americanizing Australian Railways.

Richard Speight, chairman of the Victorian Railway Commissioners, recently returned to Australia after a six months' tour in America and Europe. Mr. Speight was long connected with the Midland Railway Company here, as assistant general manager, prior to going to the colony. Very naturally he was favorably impressed with the American style of railroad cars, and the distinct advantage it affords of communication from one end of the train to the other, and his idea is that upon the main trunk lines of the colonial railways the example of America in providing these through cars might be adopted. The sytem of "checking" baggage on to the station at which the passenger intends to leave the train, and of an "express" agent entering the car *en route* for instructions as to delivery of the baggage at the destination of the passenger, for a small payment, was regarded as a great service, and a decided reason for the adoption of the through car, by which alone the baggage conductor was enabled to receive the necessary instructions. But Mr. Speight would have this system under the direct control of the railway authorities, and not of an outside "express" company.

The point, however, which had greater attention with him, was the carriage of dead meat and other perishable goods, at present a problem demanding solution in Victoria. The system of carrying such goods in America is by icing the cars, and this railway experts declare a most suitable one. As Victoria cannot get natural ice, Mr. Speight investigated the various methods of producing ice artificially. Many establishments were visited, and Mr. Speight has obtained particulars as to the best means of making ice for railway and other public requirements. He has also obtained plans and specifications of what would be required by the department, from a railway point of view, and he intends to recommend the establishment of ice-making machines. Arrangements have also been made whereby samples of the best cars running in America may be sent out to the colony to thoroughly test them.—*Engineering.*

The non-Bessemer iron mines of the Lake Superior district are being bought up by Ferdinand Schlesinger of Milwaukee for a German syndicate. All the non-Bessemer mines of the Menominee range are now controlled by the syndicate; and negotiations are in progress for the purchase of the Winthrop and Mitchell mines, near Ishpeming, whose annual output is over 150,000 tons. The Buffalo and South Buffalo mines, near Ironwood, are also to be purchased. The syndicate proposes to build a railway from Crystal Falls to Escanaba, about 90 miles, to take their output directly to the lake where it can be shipped by water.

PERSONAL.

Mr. P. P. Shelby has been appointed Assistant General Manager of the St. Paul, Minneapolis & Manitoba.

Mr. A. S. Stevenson, President of the New Brunswick Railway Company, died at Montreal, Sept. 8.

Mr. Geo. R. Conner, formerly Commissioner of City Works, Brooklyn, N. Y., died Sept. 12.

Mr. H. R. Talcott has been appointed Chief Engineer of the Seattle, Lake Shore & Eastern Ry.

Hon. A. E. Touzalin, of Chicago, President of the Chicago, Burlington & Northern Railway Co., died at Bennington, Vt., Sept. 12.

Mr. William H. Cilley, the associate of the late Gen. Meiggs in the construction of the celebrated Oroya Railway in Peru, died in Lima, Peru, Sept. 10.

D. Shanahaan & Co., contractors for the Richmond, Nicholasville, Irvine & Beattyville Ry., have moved their office to Richmond, Ky.

Mr. Samuel L. Cooper has been appointed by Comptroller Myers, New York City, as engineer to superintend the construction of the new street pavements; salary, $2,500.

Superintendent Porter has appointed Mr. Chas. A. Ashburner and Mr. John H. Jones special agents to collect the statistics of coal for the eleventh census.

Mr. Thomas C. Platt, of New York has been elected President of the Tennessee Coal, Iron & Railroad Co., of Nashville, Tenn., to fill the place made vacant by the death of Hon. John C. Brown.

Mr. W. J. Harahan has been appointed Engineer of Maintenance of Way of the Cincinnati division of the Chesapeake & Ohio, with headquarters at Cincinnati, O.

Mr. Geo. W. Beale, who has for twenty years occupied the position of Superintendent of the Portland Locomotive Works, Portland, Me., has resigned.

The Northwest Society of Civil Engineers and Architects, at St. Paul, Minn., has elected Mr. D. D. Neer First Vice-President, in place of Mr. William Stokes' resigned.

Mr. A. G. Menocal, Chief Engineer of the Nicaragua Canal, sails for Greytown to-day. Mr. J. Foster Crowell accompanies him in an independent capacity to examine the work. Mr. J. Francis LeBaron is the Resident Engineer in charge.

Major O. H. Ernst, U. S. Engineer, has been appointed Superintendent of Public Buildings and Grounds of the District of Columbia, vice Col. J. M. Wilson, appointed commandant at West Point. Major Ernst has been engaged for some time in charge of the improvements at Galveston.

Mr. F. G. Shaughnessy, Assistant General Manager of the Canadian Pacific railway, has been appointed Assistant President of the road. He will go to England at once on business connected with the contract for Pacific mail steamers.

Mr. H. N. Burford, Superintendent of the Motive Power Department of the Texas & Pacific road, died at Marshall, Tex., Sept. 6. He served as Master Mechanic for the Memphis & Charleston shops for about 15 years before accepting the position on the Texas & Pacific road on June 1, 1888.

Mr. Henry Taylor, of Scottdale, Pa., who has been General Superintendent of the Southwest Pennsylvania Railroad for 5 years past, has resigned to fill the position of Superintendent of the Leisenring coke works of the H. C. Frick Coke Co. His successor is Mr. David Steele, of Irwin.

Mr. John Coffin, Chief Engineer of the Johnson Co., of Johnstown, Pa., died at Johnstown on Sept. 3. He was born at Chatham, N. Y., on Sept. 18, 1856. He studied engineering at the Cornell University, and subsequently took charge of a machine shop at Syracuse, N. Y. In 1881 he located at Johnstown, securing a position in the draughting department of the Cambria Iron Works.

Judge Wheelock Graves Veazey, of Vermont, has been appointed by President Harrison to succeed Mr. Aldace F. Walker on the Interstate Commerce Commission. Judge Veazey is a native of Rutland, Vt., which place is now his residence. He was graduated from Dartmouth College in 1856, and from the Law School at Albany, N. Y., a year later. Entering the volunteer service of the Union, he attained the rank of colonel. In 1879 he was appointed a judge of the Supreme Court of Vermont, and has received successive elections from the Vermont Legislature since that time. He became a trustee of Dartmouth College in 1880.

BOOK REVIEWS.

Fourth Biennial Report of the State Engineer to the Governor of Colorado for the years 1887 and 1888. Part II. Second Edition. Denver, 1889. Published by the State. Paper covers, 23 plates.

Part II. of this report consists of maps and diagrams relating to irrigation. These maps and diagrams were prepared in the office of State Engineer J. S. Greene, from reports by the Water Commissioners and by the observers at the various stations for gauging the flow of streams. Part I. of the report was reviewed in our issue of July 27. It contained text to accompany the maps and diagrams and other matter pertaining to irrigation in Colorado.

The first plate in Part II. is a drainage map of the State, showing the six water divisions and the 68 or more water districts, as amended and created by the Legislature of 1889. This map is engraved in colors, to make distinguishable the water districts, and is batched at the boundaries of the six water divisions.

Plates II. to XIV. are maps of 13 of the water districts, showing in blue the natural, and in red the artificial water courses or canals.

It is much to be regretted that maps are not given of each water district in the State, but this was impossible in the present report, as the preliminary work was done by the Superintendents and Commissioners of Irrigation, and it was not deemed advisable to call upon all of these for the necessary data. Moreover, the statute provides that the Water Commissioner shall receive pay for but 80 days in a year, and his assistants for but 25 days, and, in addition, the appropriation for the expenses of the State Engineer's office, during this period, was not sufficient to pay for the services of the assistants that would have been necessary had more work been done. Thus an inadequate force, caused by lack of available funds, prevented the presentation of complete data. The start in this direction demonstrates both the possibility and desirability of presenting complete irrigation maps of the entire State, and doubtless this will be done in the next biennial report.

It is not claimed that the maps under consideration are minutely accurate, but that they, with the accompanying tables (noted in our review of Part I., referred to above), give a good general idea of the irrigating ditches already opened, with some accurate statistics concerning the same. Such a presentation State Engineer Greene deemed much preferable to an attempt to issue elaborate maps, which would not be available for some time to come. All that has been done has been made immediately available, and will serve as a basis for future and more accurate and elaborate maps and statistics.

Plates XV. to XXIII. are graphical presentations of the daily mean discharges in cubic feet per second of the Cache la Poudre, Arkansas and South Platte rivers, the Clear, St. Vrain, Bear, Boulder, Big Thompson and Big Boulder creeks. The diagram for the Cache la Poudre river covers the five seasons, 1884 to 1888, while the observations on the other streams were of shorter duration and not in every case unbroken.

We refer editorially in this issue to the subject of irrigation reports and investigations.

Reclamation of Arid Lands by Irrigation. Report of Committee on Arid Lands of the California State Board of Trade. M. M. ESTEE, W. H. MILLS, F. H. CUNNINGHAM, E. W. JONES, L. M. HOLT, WM. THOMPSON, C. C. WRIGHT, JESSE D. CARR, N. P. CHIPMAN, Committee. San Francisco, 1889. Pamphlet, 52 pp.

The main questions investigated and reported upon by the above committee are:

What is the physical condition of California, so far as it relates to irrigation? What amount of irrigable land is there in the State? What amount of water can be obtained for the purpose of irrigation? In this connection does irrigation pay? What is the condition of irrigation as at present practised in California, and what interest has the National Government in the subject of irrigation on the Pacific coast and in relation to all that extent of country known as the "Arid Region" which lies west of the Missouri river?

Each of these questions is as fully discussed in the report as could be expected. The committee claim that California possesses unsurpassed natural advantages for irrigation, as large tracts of arid land are so located as to make irrigation comparatively easy and cheap. This is particularly true of the valleys of the Sacramento, San Joaquin, Mojave and Colorado rivers, and their tributaries.

One of the most important points to consider is the rainfall in various parts of the State. This is quite large in amount for the whole year, but most of the rain falls when not needed for crops, and, moreover, the total fall varies greatly from year to year, so that it is impossible to know how much can be relied upon. The average rainfall at San Francisco is 23.5 ins.; in the foothills of northern and central California it exceeds 30 ins.; in the great valleys of the State it is generally much less, but increases from about 7 ins. at the lower end of the San Joaquin valley to 35 ins. at the upper end of the Sacramento valley.

The committee estimate that there are about 13,000,000 acres of irrigable land in the State, and that for each irrigable acre there are 3½ acres of unirrigable land acting as a watershed. The latter areas are located at high altitudes where the annual fall of rain and snow is very great.

The benefits resulting from irrigation are shown by the increased price of land, and its rapid settlement since water was placed upon it. In some cases this increase in price has been 1,000 per cent.

Some of the means suggested to make available plenty of water for irrigating purposes are the boring of artesian wells, the building of submerged dams in the gravel-filled channels of streams, the construction of storage reservoirs on the bench lands and in the mountains, and the collection of water from springy lands by means of under-drainage. Sub-irrigation is spoken of, but hardly approved.

The Committee says:

Storage reservoirs will become a necessity in the irrigation of the arid lands of America, as they are in irrigating the plains of India; and the Government should take a hand in reclaiming these lands, either directly, or by advancing the funds to do the work, to be paid back after the lands are made productive.

The report closes with an answer to the question, What interest has the National Government in irrigation? In this connection the Committee says:

We are not now proposing that the Government of the United States from its treasury shall construct the instrumentalities of irrigation. What we ask, and what we hope will be granted, is that the preliminary cost of ascertaining all the economic facts necessary to induce capital to enter upon the completion of this great work shall be borne by the Government of the United States, and, when the public lands are affected, make such appropriations as may be wise. Let it once be shown by conclusive data that a reasonable reward awaits the investment of capital in the reclamation of the arid lands belonging to this nation, and private capital will not long be wanting to engage in that undertaking. We believe, therefore, that the proposed surveys for reservoir sites, and the approximate ascertainment and publication of the possibilities for the reclamation of the sterile portions of our country, to be in consonance with the wisest statesmanship.

PUBLICATIONS RECEIVED.

—*Pumps and Pumping.* A Handbook for Pump Users. Being Notes on Selection, Construction, and Management. By M. POWIS BALE, M. E., London, 1889. Van-Nostrand Co., N. Y. Price $1.00.

The title to the above book is about all that is necessary. It sufficiently explains the scope of the book. The literature on the subject of pumps and pumping is confined almost exclusively to the trade catalogues of pump makers. This book, the most ambitious on the subject yet published, cannot fail to be of value, and we prophesy a good demand for it. It is a very cheap book at the price.

SOCIETY PROCEEDINGS.

Engineers' Club of St. Louis.—The club met at Washington University, Sept. 11, President MEIER in the chair, 16 members and 2 visitors present. The secretary read the letter of Aug. 7, 1889, from MR. WM. P. SHINN, chairman of the American Society of Civil Engineers' committee on revision of its constitution and by-laws. The letter suggested the appointment of a committee representing the Engineers' Club of St. Louis for the purpose of conferring with the American Society's committee, with a view of determining whether a satisfactory basis can be established for affiliation between the American Society and the local organizations. The secretary made a verbal statement of the consideration which had been given this subject by the Executive Committee in conjunction with the club's special committee on closer union of engineering societies. These deliberations had resulted in the following report:

Your Executive Committee recommend that a committee of three be appointed by the chair to confer with the committee of American Society of Civil Engineers and with the other clubs on a plan of union on the following basis:

All local organizations to become chapters of the American Society of Civil Engineers, and to have the exclusive right of electing to grade similar to the present grade of "Associates," subject to some general minimum scale of qualifications.

Such members of the local organizations as are not now members of the American Society of Civil Engineers to become "Associate" by their clubs entering this union.

The only other grade of membership to be Member of the American Society of Civil Engineers, and these to be elected as at present by the members of the American Society of Civil Engineers.

And further, in the event of a conference being called between other committees, that the committee of the St. Louis club be authorized to send delegates to such conference.

MR. SEDDON made a verbal explanation of the committee's report. MR. RUSSELL read reports which had been made by local members of the American Society of Civil Engineers in Chicago and in St. Louis. The sentiment was entirely favorable to the proposed affiliation. President MEIER gave some further explanation of the different points, which had been considered in committee. MR. R. E. MCMATH suggested that, the proposed action being of great importance, it could perhaps be more clearly understood and acted upon by dividing the measure into three parts:

1. Shall this club appoint a committee as proposed? 2. If the club appoint a committee, shall it be empowered to send a representative to a conference? 3. What plan of action, if any, shall this committee be authorized to promote?

He further moved that the chair appoint a committee on a plan of union, as proposed in the report of the Executive Committee. This motion, being seconded by MR. ROBERT MOORE, was on vote carried. MR. MCMATH then moved that the committee be authorized, with the consent and approval of the Executive Committee, to send a representative to the proposed conference at the expense of the club. Seconded and carried. MR. ROBERT MOORE moved that the committee be authorized to act in the general line mapped out in the Executive Committee's report, as expressing the sense of the club. Seconded and carried. President MEIER appointed as such committee ROBERT MOORE, R. E. MCMATH, and J. A. SEDDEN.

W. H. BRYAN, *Secretary.*

The New England Railroad Club.—The first regular meeting of the Club after the summer vacation was held on the evening of Sept. 11, at the United States Hotel, Boston, Mass. A reception was held from 6 to 7 o'clock, after which an elaborate dinner was served. President RICHARDS then called the assembly to order, and announced that hereafter the meetings of the Club would be held at the United States Hotel. Speeches were made by several of the members of the Club, brief notes of which we give as follows:

President GEO. RICHARDS.—The object of this Club is to promote a knowledge of the things relating to the construction, equipment, and operation of railroads, and to make possible social intercourse among the members. The importance of this intercourse amongst the members cannot be overrated. It is only by such interchange of knowledge, and through books, that a man can be posted as to what is going on in the world, and what has been done in the past.

It is a common saying that almost every man has a hobby. GEORGE STEVENSON had a hobby: he rode it to success. GEORGE WESTINGHOUSE has a hobby: the result of that hobby is seen on all the roads to-day. We find hobbies in great variety amongst railroad men. Sometimes they become a nuisance; sometimes they are otherwise. One day we see a man with a new locomotive, which is to supersede all those now in use; the next day a man with a patent oil-box, which saves all the oil, besides manufacturing a good deal more; then another with a patent automatic coupler (followed by a man with a shot-gun); then a man with a patent switch, which is sure to be safe, or a man with a wheel that never breaks.

Now the business of the Club is to take all these hobbies, to investigate them, select the good and reject the bad, proving all things, and holding fast to that which is good.

Ex-President J. N. LAUDER.—I want to say a word with reference to the influence which these clubs have on the railroad profession. This Club was started some six or eight years ago, and its members have worked hard to make it a success. The railroads of New England especially, and perhaps of the whole country, have profited by the discussions that have taken place in this Club. Different subjects have been taken up and discussed very thoroughly. I never went away from a meeting of the N. E. R. R. Club without knowing something I didn't know before.

There is one thing which I think might tend to increase the good we do; that is, to try to introduce other departments of railroading to join us to a greater degree than they do now. This is a Railroad Club; it is not a Master Mechanics' Club, or a Master Car Builders' Club, or an Engineers' Club, but it is a Railroad Club. It is just as proper for this Club to discuss the track the best methods of laying the track, how to put up signal poles, and what we shall have as a code of signals, and various other things, as to discuss the question of rolling stock. But we never have seemed to be very successful in getting into the Club those interested in the other departments. I should be glad to see a strong representation in this Club of the track-men, road-masters, and engineers. I should be especially glad to see that class of railroad mechanics identified with us, because the relation between the matters which they control and the matters which are controlled by those who have charge of the rolling stock is so intimate that it is very appropriate that the men in control of the two departments should meet and discuss these questions together.

I move that the subject for discussion at our next meeting be, "The Permanent Way and Rolling Stock, and Their Relation to Each Other," and that the Secretary be instructed to invite the New England Roadmasters' Association to join us at that meeting and discuss this question with us.

MR. LAUDER'S motion was carried.

E. M. LEWIS:—The discipline of railroad work has developed in this country a class of men more truly educated, in the true sense of the word, than any men have been in any past age of the world. You take a man from some other position and change him into a railroad man, he is not a bit smarter than he was before: it is the education he gets in his business which makes him a different man.

The knowledge required to build cars and locomotives, and operate them, is true scientific knowledge. We hear a great deal about practical men and scientific men. There is no difference. The practical man starts from that door, and the theoretical man starts from this door; if the one's practice is a correct practice, and the other's theory is a correct theory, they meet midway, and the end they reach is the same. The men who build cars and locomotives, who deal in steam pressures and the strength of materials, are working in the same way that all studious men have been working in all ages in the same department. They are educated men, no matter if their book learning be small. I think the fact is recognized by all that too much education cannot be given to those who pursue this business of railroading. These men have what is called practical knowledge, but such a man will have his boy educated at a technical school, and that fact is answer enough to those disposed to decry scientific knowledge and set up practical knowledge.

Ex-President JAMES W. MARDEN.—We have before us this winter some very hard work to do in our railroad clubs, and especially in the New England Club. It may be said, perhaps, that railroad topics have been worn threadbare, but I assure you that every day there are things coming up in my work, in every-day matters, that have been discussed time and time again, in which I should like to have the opinion of my co-laborers.

I hope we shall be able to get together often during the coming winter, and make our meetings so attractive that each succeeding meeting shall be an improvement on the last.

Ex-President F. D. ADAMS.—I read in a Boston paper a few days since that any railroad which would not adopt an automatic coupler and a train brake should have its charter annulled at once. If the writer would look at the matter seriously, and inquire into the cost, he would find that there are about a million cars in this country, and to equip them with train brakes would cost $50 to $100 each. The cost of the brake is $50, and there is the expense of putting it on. Where is this money to come from? The newspapers don't stop to consider the time and labor and money required for such a thing. So with the automatic coupler. They think it is easy enough to get an automatic coupler to work beautifully; but you can't find a trainman to-day who will vote for the automatic coupler.

The American Public Health Association will hold an exhibition and its annual meeting at Brooklyn, N. Y., Oct. 22-25. This Association comprises over 800 members, devoted, officially or otherwise, to its declared purpose—the advancement of sanitary science and the promotion of organizations and measures for the practical application of public hygiene. In the furtherance of this purpose it has met annually, during the last 16 years, in different cities of the United States and Canada. With the hope of still further magnifying this interest and effort, the Association provides this year for an exhibition of everything adapted to the promotion of health.

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EDITORS.
CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER
ASSOCIATE EDITORS.
GEO. H. FROST . . . . . BUSINESS MANAGER

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Coming Technical Meetings.

American Institute of Mining Engineers.— The 55th meeting will be held at Ottawa, Ont., beginning Oct 1. Local Secy., B T. A. Bell 14 Metcalf St., Ottawa. Secy., Prof. R. W. Raymond, 13 Burling Slip, New York City.

American Society of Civil Engineers.—Regular meeting Oct 2 "Hydraulics of Fine Streams" by John R. Freeman. John Bogart, 127 E. 23d St., New York City.

Association of Civil Engineers, Dallas, Tex. — The next regular meeting will be held Oct. 4. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Kansas City, Mo.—Next meeting, Oct. 7. "Tests and Observations on Building Stones," J. A. L. Waddell and W. D. Jenkins. Secy., Kenneth Allen, 310 Baird Building.

American Forestry Congress. — Annual convention at Philadelphia, Pa., Oct. 15 to 18. Secy., J. W. Harrison, Franklin Falls, N. H.

Boston Society of Civil Engineers. — Next meeting, Oct. 16. Secy., S. E. Tinkham, City Hall.

We have neglected to note elsewhere, in connection with the views of the Colorado cañon in this issue, the important fact that the views show nearly the highest stage of water for this year, which is a rather dry year.

We trust and believe the report is not authentic that the Committee appointed to select a proper site for holding a World's Exposition in 1892, which is in session as we write, has concluded to recommend appropriating Central Park above 96th St., or practically half of it as part of the site. As noted elsewhere, the prospects seem to increase that the exhibition will be held in New York, and if necessary the sacrifice of part of Central Park ought to be made; but it is not necessary. There are at least two points on Manhattan Island where the necessary 200 acres or so (which is all that is really needed) can be obtained, viz., at the Inwood and Fort George site, which seems to us the best and really most accessible, and in the beautiful Morningside-Riverside Park district, north and northwest of Central Park. From one of these two sites the choice will doubtless be made, unless the present seeming insurmountable difficulties in connection with the Central Park site can be overcome.

The news item in regard to the Manchester ship canal, which we publish elsewhere, shows that one great canal enterprise at least is likely to be completed within the time and cost estimated. Work began practically with 1888, and in the 20 months since, 25,000,000 out of an estimated total of 44,000,000 cu. yds. has been completed, the present monthly cube being upwards of 1,000,000 cu. yds. It is, therefore, already practically assured that it will be completed by the date originally set Jan. 1, 1892, if not considerably before that date; and it is still more certain that its original share capital of $40,000,000 will more than suffice for building it. These facts go to still further enforce the conclusion which we have repeatedly expressed, that there is nothing in the Suez or Panama experience which ought in justice to throw discredit on the carefully made estimates of engineers in regard to the Nicaragua or any other canal project. The Suez canal was managed badly, in part from necessity and in part from ignorance, and was never carefully estimated for, in advance. As for Panama, a kind of crazy enthusiasm born of success at Suez, rather than knowledge and engineering skill, was from the beginning its impelling force. These great projects, moreover, were under the management and control, not of an engineer, but of a great projector only, whose first success under easy constructive conditions completely blinded him to the magnitude of difficulties which he declined even to inquire into in advance. Not from either of these can we fairly draw auguries as to rationally conducted engineering enterprises.

The article on the Croton watershed, in another column, discusses a question which has been often raised before, especially of late years, and of which it is difficult to see the equity. The city of New York must have water; the Croton basin has been for half a century its source of supply. The demand for water must increase; the normal flow does not increase. The natural resource is storage of water; and the inevitable result of storage is that a certain large area is to be alternately lake and dry land each year. That this is not a very desirable thing to have happening yearly in the vicinity of one's residence is too evident for discussion, and it is alleged, with no little apparent reason, that it already has a very depressing effect upon real estate values in the Croton basin, and is destined to have a further and worse effect. If so, the equitable claim for compensation of property holders whose land has not been taken, but only injured, is very strong; but how is the existence and extent of the injury to be proven? Certainly not by such vague statements of facts as appear in another column. Connecticut townships make rapid advance, not only by "emigration from New York," but by numerous local manufactures; New Jersey townships grow, not only because they have superior attractions for residence in themselves, but because they have better train service. The New York Central has never (or not till very lately) condescended to give a good local train service and low commutation rates, and after it has given both, its service only extends to 42d St., three miles or more above the point which most business men wish to reach. Our opinion is that this latter fact has more to do with the slow growth of Westchester Co. than any other, and that if that county could and would build a true rapid transit line down to the very heart of lower New York, it would speedily be as much in advance of other suburban districts as it is now behind them, and get its money back many-fold. Certainly, in natural beauty it leads them all.

Our humble apologies are due and tendered to the Massachusetts Institute of Technology for having made its establishment of a course in sanitary engineering the text for a brief sermon, in our editorial pages of last week, against a sin which it, almost alone of prominent technical schools, is *not* guilty of, viz., dubbing young students "C. E.'s," or "M. E.'s," or "E. M.'s," as the result of four years study only, or as the result of a merely formal waiting for a year or two after graduation. On the contrary, the Institute of Technology does as all colleges ought to do,—enables the young student to modify his course of study according to the supposed bent of his genius, but confers the degree of "S. B.," Bachelor of Science alone, on graduation from any of its regular courses. Moreover, the only degrees to be had from that institution, even by post graduate study, are, for one year's study, the degree of "M. S.," Master of Science, and for two years' study, Doctor of Philosophy, or Doctor of Science. The degree of "C E.," etc., is treated as one not properly conferable as a result of collegiate studies alone, and the implication is decided in favor of the position which we have repeatedly taken, that the only "C. E." degree which, in the nature of things, can ever have any real meaning or value is that of "M. Am. Soc. C. E.," conferred in effect by the aspirant's professional peers, when he is admitted as a member of a national society of civil engineers on an equal footing with them. On the other hand, the time is near at hand, if not already come, when it will require the most unquestionable proof of actual competency as a civil engineer, both theoretical and practical, to obtain admittance to that body as a full member, without such graduate degree of B. S., or whatever it may be.

The catalogue of the Institute of Technology reads as follows on the subject of courses and degrees, the italics being our own:

REGULAR COURSES—The following *regular courses of study*, each of four years' duration, have been established; and, for proficiency *in any one of them, the degree of Bachelor of Science, S. B., in the course pursued* is conferred.

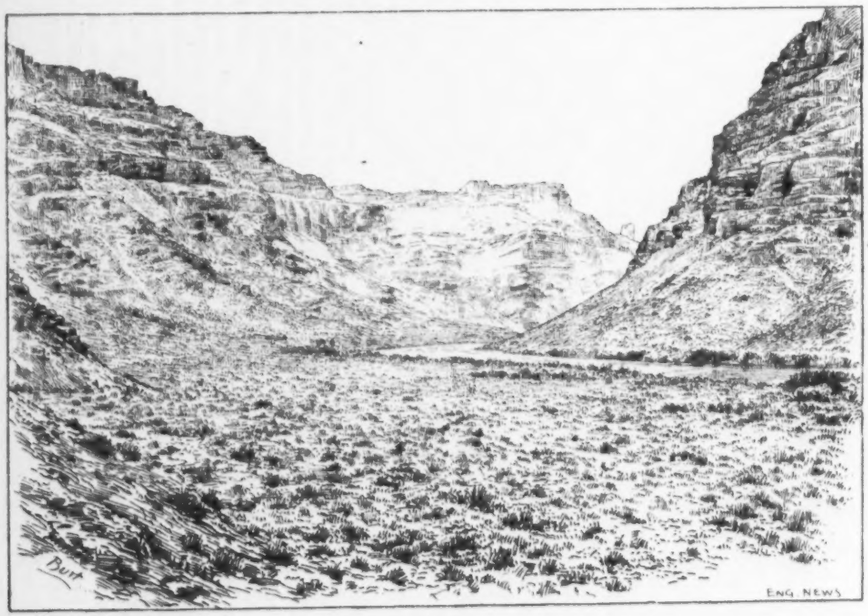
I. Civil and Topographical Engineering
II. Mechanical Engineering
III. Mining Engineering
IV. Architecture
V Chemistry
VI. Electrical Engineering
VII. Natural History
VIII. Physics.
IX. General Course
X. Chemical Engineering
XI. Sanitary Engineering

Many of the graduates do in fact assume the initials C. E., M. E., etc., after obtaining their degrees,—a circumstance which led to our inadvertent injustice; but they have no more official warrant for doing so than have the numerous non-graduates of any college who assume the same initials. The Institution of Civil Engineers has by formal vote condemned this practice. The American Society of Civil Engineers might well do so likewise; but so long as the title is indiscriminately conferred by technical schools as the result of a few years' elementary study, they are not likely to do so; since it will with reason be claimed that the man who has established his rank as a civil engineer by years of successful practice has as much inherent right to use the initials C. E., if he chooses, as those who have been falsely certified to be "C. E.s" by college officials who in fact know better. Should the American Society of Civil Engineers take up the subject in a recommendatory way, its recommendations would very probably lead to a general agreement to follow the sensible course which is

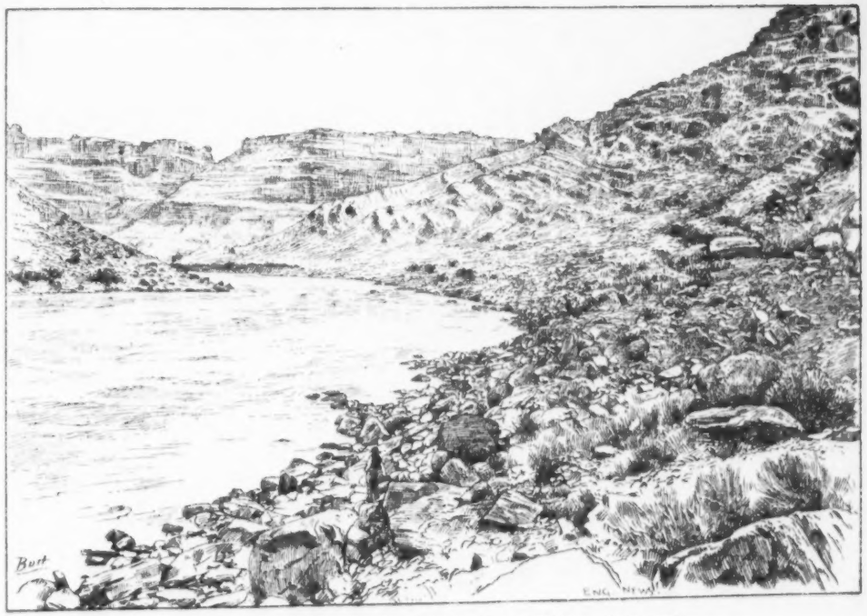
THE CAÑONS OF THE COLORADO RIVER.

SELECTIONS FROM PHOTOGRAPHIC VIEWS TAKEN ALONG THE ROUTE OF THE PROPOSED DENVER COLORADO CAÑON, AND PACIFIC RAILWAY, SHOWING THE GENERAL CHARACTER OF THE WORK.

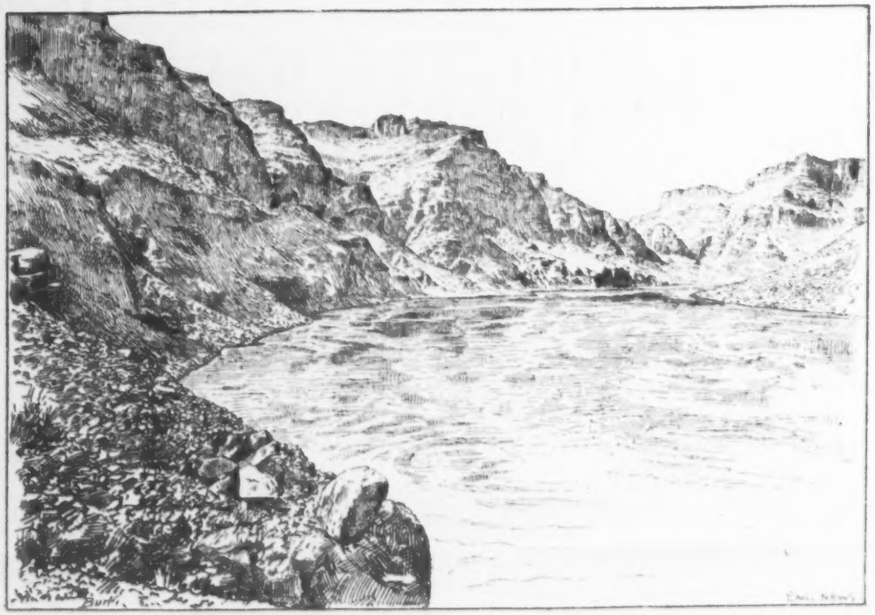
FRANK M. BROWN, President. ROBERT B. STANTON, Chief Engineer.



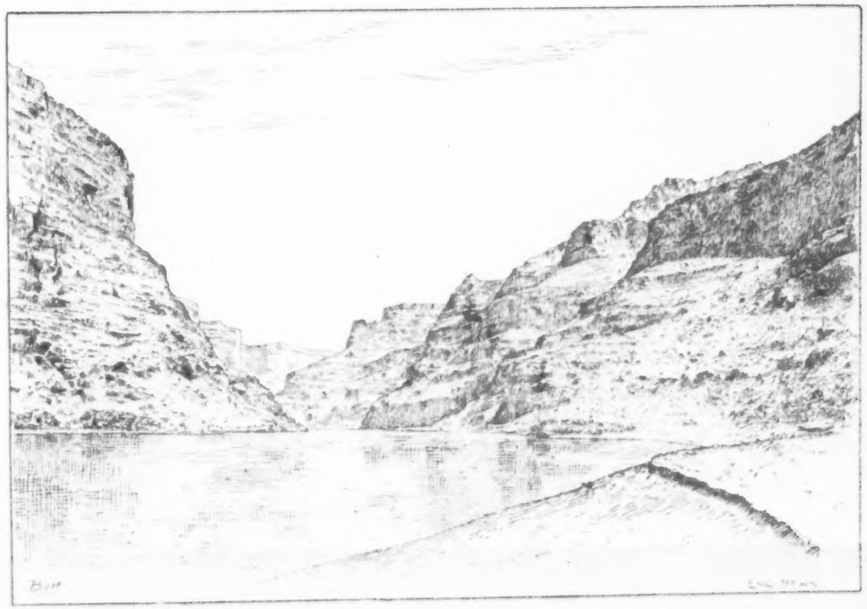
CATARACT CAÑON; BEST CLASS OF WORK. (Photo. 47.)



CATARACT CAÑON; AVERAGE CLASS OF WORK. (Photo. 57.)

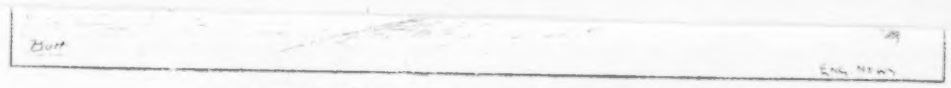


CATARACT CAÑON; WORST CLASS OF WORK. (Photo. 51.)

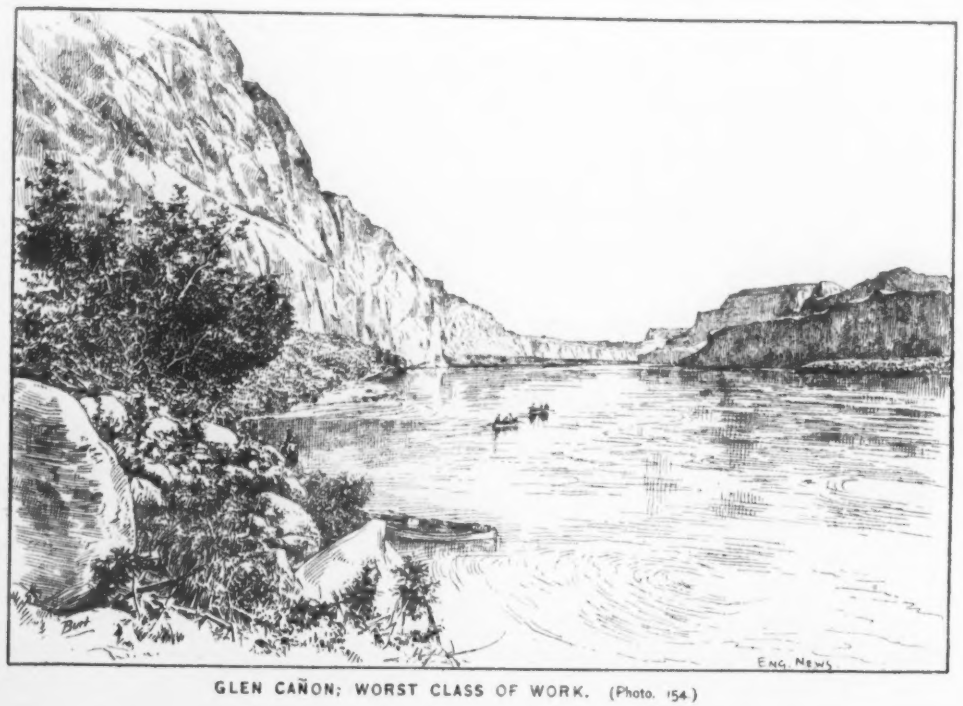


NARROW CAÑON; WORST CLASS OF WORK. (Photo. 119.)

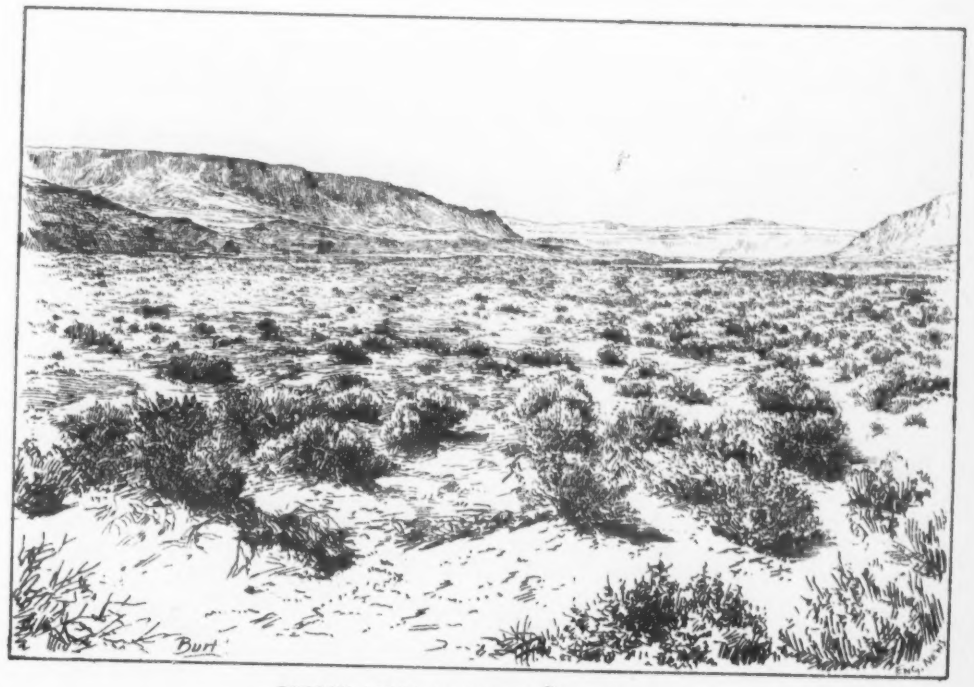
CATARACT CAÑON: WORST CLASS OF WORK. (Photo. 52.)



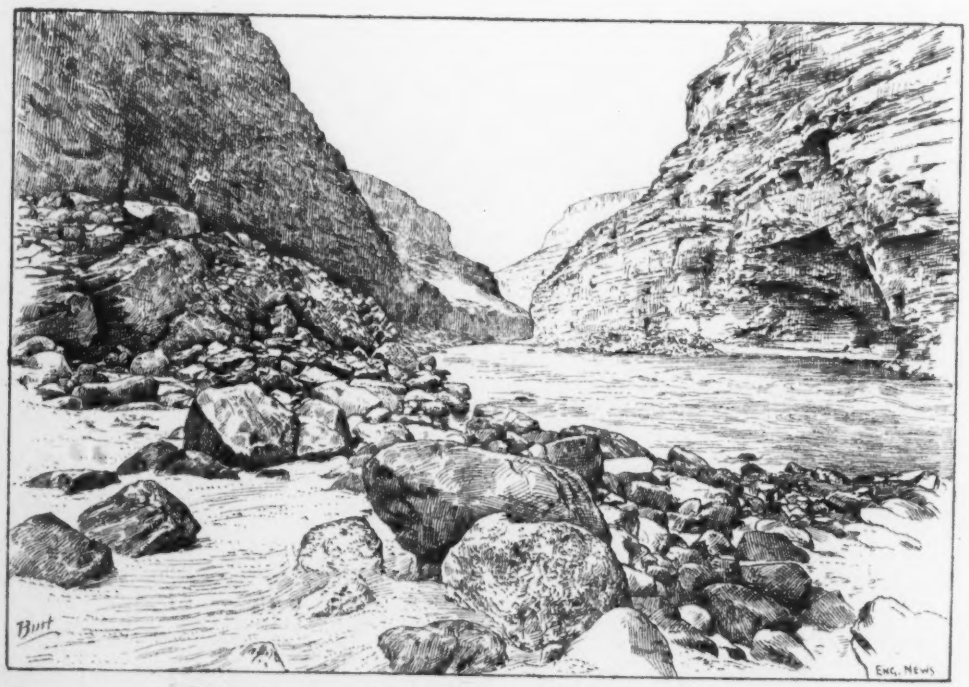
NARROW CAÑON: WORST CLASS OF WORK. (Photo. 110.)



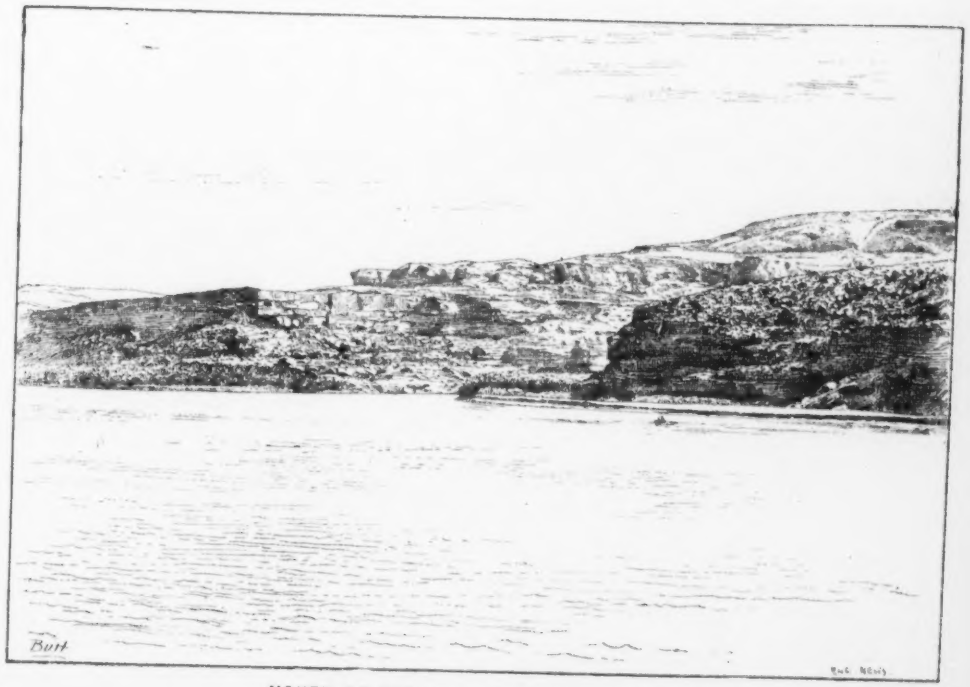
GLEN CAÑON; WORST CLASS OF WORK. (Photo. 154.)



BOTTOM LANDS IN GLEN CAÑON. (Photo. 135.)



BENCHED FORMATION IN HEART OF MARBLE CAÑON. (Photo. 189.)



MOUTH OF THE SAN JUAN RIVER. (Photo. 145.)

now the practice of the Massachusetts Institute of Technology, if properly presented to the technical schools.

FROM the list of graduates which appears in the Massachusetts Institute of Technology catalogues, we have had the curiosity to make a tally of those graduated in the civil, mechanical, and mining engineering courses of that school prior to 1880, with a view to seeing how many of them have actually stuck to the professional specialties contemplated by them before graduation. The result is as follows, showing a very fair degree indeed of persistency in the elected line of work:

	C. E. course	M. E. course	E. M. course	Total
Still in same branch of engineering	46	21	14	81
In some other branch of engineering	2	—	11	13
Architects and chemists	2	1	2	5
Manufacturing, managing officers of corporations, etc. in callings for which engineering studies are a preparation	11	8	8	27
In business having no relation to engineering	11	2	7	20
Law and army	2	—	1	3
Professors in Engineering schools	7	3	2	12
Dead	8	8	3	19
Unknown	3	1	1	5
Total	92	44	49	185

Deducting the dead and unknown, a full half have stuck to the precise line that they laid out for themselves in advance; and if we include those who have become professors likewise, as is but proper, considerably more than half. Nevertheless, about a quarter of all of them have gone into stock-raising, banking, and other like occupations which would make their carrying about with them certificates on parchment that they were likewise "civil engineers" a decided absurdity. It is to the credit of the Institute of Technology that it confers no such privilege upon any one.

ONE of the most remarkable, and, we may say, promising issues of a daily journal which it has ever been our fortune to see is that of the San Francisco *Chronicle* of Friday, Aug. 23, 1889, which we listed last week among our "Publications Received." Instead of the mess of scrappy trash which such immense blanket sheets usually contain, this issue has an eight-page supplement which is wholly devoted to a really excellent and readable treatise on irrigation, divided into 18 chapters, and containing a great mass of facts on the subject, which will insure the permanent preservation of the issue by every engineer who obtains it and has any interest whatever in the question of irrigation. We propose to use the information in this issue as text for a fuller discussion at some later date; in the meantime we only say that the article is full enough and well enough written to enable the interested reader to fully grasp the pros and cons of the really great question to which it is mainly devoted, that of reclaiming what are known as the arid regions on each side of the Rocky Mountains; and it appears to us, from our as yet hurried reading of it, that the case in favor of an attempt, on a large scale, to reclaim this arid area by wholesale is fully made out. It is impossible to imagine a question bigger with importance to the future of this country; for, should it prove as feasible as is claimed and expected, it will give a stimulus such as nothing else has ever given to the material development of this country. That a daily newspaper should do so much for the dissemination of solid and useful information is something so unusual that we have thought that fact alone worthy of special note.

Irrigation Reports and Investigations.

The Fourth Biennial Report of State Engineer J. S. GREENE, of Colorado, Part II. of which is reviewed elsewhere in this issue, and Part I. of which we reviewed July 27, is the nearest approach that has yet come to our notice of a complete report regarding the irrigating status of any of the States or Territories in the "arid regions."

Some time ago Mr. WM. HAM. HALL, then State Engineer of California, collected much valuable data regarding irrigation in that State, and under his direction a volume was published describing the irrigating works of southern California. A volume for the remainder of the State, and an elaborate map of the whole State, would have been issued in due time, but before this was accomplished the office of State Engineer was abolished, and Mr. HALL's data turned over to the State Mineralogist, where it has since been pigeonholed, and much of it, as ancient history, has now become of little value. As we noted last week, preparations have been made to carry on this work, but some technical error in the appropriation bill seems likely to cause still further delay.

The Governor of Utah recently asked water commissioners, county officials, and others interested to collect irrigating statistics and prepare maps for their districts or localities, and some work of this nature has been done, but it has been without general system. The Territorial Secretary of Wyoming recently published a pamphlet entitled "Resources of Wyoming," which has scattered through it a little information regarding irrigation. The Kansas State Board of Agriculture, as we noted last week, has just ordered an investigation regarding the extent to which artesian wells can be utilized in that State for irrigating purposes. In addition to these official or semi-official reports and investigations, the California State Board of Trade has very recently published a pamphlet report, prepared by its Committee on Arid Lands, regarding some of the irrigating questions in that State. The latter report is noticed elsewhere in this number.

It will be seen from the above that Colorado and California alone, of all the West, have attempted to collect and publish data regarding the irrigating works within their limits, and that only Colorado has completed the work. And it may be said in this connection that, while the Colorado report is very creditable, especially to State Engineer GREENE and his assistants, there is much that is lacking both in its scope and in the failure of some commissioners to make complete returns, and of others to make any returns. This lack is owing to insufficient funds, and can easily be remedied in future years, since there is now a good basis upon which to work

The utility and necessity of statistics regarding irrigation will be better appreciated after noting some of the points covered by the Colorado report. It should be borne in mind that the State is divided into water divisions, of which there are now six; that these divisions are in accordance with natural drainage areas; that each division has over it a Superintendent of Irrigation, and is subdivided into water districts, with a Water Commissioner over each. There are now nearly 70 of these districts. It is the duty of the above-named officials to see that the water within their divisions and districts is fairly distributed to the various ditches, according to the conditions governing such distribution.

State Engineer GREENE requested these officials to forward to him certain information for use in the 1887-88 report, the character of which will be best understood by abstracting the following data from the statement of the Water Commissioner for District No. 1:

Twenty-two ditches named had in 1888 a total length of 238 miles, and there were irrigated therefrom 5,100 acres of alfalfa, 101 acres of seeded grasses, 19,120 acres of natural grasses, and 15,160 acres of other crops, making a total irrigated area of 39,719 acres. The area of land in this district that might have been irrigated "under the ditches already constructed" is about 150,000 acres, or nearly four times as much as was actually irrigated. It is not stated why the ditches are not used to their full capacity. The figures cited *in toto* above are given separately for each ditch.

In addition to these statistics, the commissioner reported for each ditch, where possible, the stream from which it takes water, the date of appropriation, cubic feet of water per second decreed to each priority, summation of decree to each ditch, canal or reservoir, cubic feet of water previously appropriated in the district, order of priority in district; also the date of filing plats or statements in State Engineer's office, regarding new ditches, time of beginning work on same, capacity claimed in cubic feet, name of claimant; and also data similar to the last regarding new reservoirs.

In addition to the above, some of the commissioners submitted statistics regarding artesian wells, giving name of owner, total depth of well, diameter and length of case, depth below surface of first, second, third, and fourth flows, present flow in gallons, and location of well.

For some of the water districts maps are given in Part II., showing the streams from which water can be taken and the ditches already constructed. In addition, Part II. contains a drainage map of the State, showing both the water divisions and the water districts into which they are subdivided; it also contains diagrams showing the mean daily discharge in cubic feet, for longer or shorter periods, of nine of the most important streams within the State.

Complete reports on a plan similar to that of the one described cannot fail to be of great value to Superintendents of Irrigation and Water Commissioners in the performance of their duties, to the owners of water rights and ditches, and to those desiring to develop land or water in irrigable sections. They would also furnish a basis for an intelligent study of the further irrigation development of a State or section, and if the whole West were thus covered by reports, the policy of the National Government regarding the general subject of irrigation could be easily and speedily determined.

The importance which the question of irrigation is now assuming can be appreciated when we consider what yet remains to be done in this line, and how much depends upon the action finally taken. Unfortunately we have not even approximately correct data regarding the areas in the West now under irrigation, unless it be in Colorado. At the close of 1888 about 2,000,000 acres had been irrigated in Colorado, through some 4,000 miles of ditches. In comparison, the total area of Colorado is some 66,560,000 acres, more than half of which would yield abundant harvests if properly irrigated. Perhaps 5 per cent. of this latter area has been irri-

gated and made productive. Practically all that section of the United States, excluding Alaska, lying west of the 100th meridian is dependent upon irrigation. This area is over one-third that of the whole United States, and it is safe to say that of this area one-third would be productive, if irrigated, or at least 350,000,000 acres. In 1880 the total productive area of the United States, as given in the tenth census, was about 285,000,000 acres. Making due allowance for increase since 1880, the present productive land of the United States is undoubtedly equalled, if not exceeded, by the vast areas of the far West that only await irrigation to become as good as the best arable land in this country.

The future development of the far West depends so largely upon irrigation, and the general growth and prosperity of that section will be so nearly in direct proportion to the development of its irrigating facilities, that it is of the utmost importance, both to the West and to the remainder of the United States, that every wise measure be adopted to further the reclaiming of the "arid regions."

At present the great drawback to definite steps towards this reclamation is a lack of data regarding existing irrigating works and the best methods of extending them. How much of the naturally available water supply is now utilized? How much more could be developed? How can additional water best be developed and applied? These are now unanswerable questions, and will remain so until the western States and Territories, or the National Government, make and record the necessary investigations.

If the expense of collecting and publishing the needed data is more than the individual States and Territories, or some of them, can bear, then the National Government should come promptly to their aid. Statistics regarding existing works are of such value to those benefited by them that they can well afford to pay their share of the State or Territorial expense of collecting them, and most of the States and Territories are, at least, able to gather and publish full information regarding irrigating works already in operation.

Investigations for the purpose of determining methods for increasing the general available water supply may very properly be carried on by the National Government, and in some cases there is quite as much reason for the building of large storage reservoirs by the Government to reclaim arid lands as there is for the construction of levees to reclaim flooded areas. This is especially true where the areas to be benefited are largely government lands. As we noted last week, the United States Geological Survey, through its topographical division, surveyed, during the month of July, 3,650 sq. miles in California, Nevada, New Mexico, Colorado, Idaho, and Montana, and the work was done to help solve the irrigation problem. This and additional surveys, together with the extensive trip now being taken through the West by the Senate Irrigation Committee, will undoubtedly result in recommendations to the next Congress for large national appropriations to be used in reclaiming the "arid region." But, meanwhile, it is very desirable that the *present* extent of irrigation, and the benefits resultant therefrom, be fully and accurately ascertained, so that comparisons of different methods may readily be made and deductions drawn to govern the future policy of the National and State Governments, and of those capitalists who have invested or may invest their money in irrigation.

The data at hand, as we have shown above, is meagre. It is much to be hoped that Colorado will carry to completeness, in 1889 and 1890, the creditable work begun in 1887 and 1888; that California will finish the work begun there so long ago, bringing the information down to date for the whole State; and that the other Western States and Territories will follow and improve upon the example of Colorado and California.

With such a groundwork to build upon, the eleventh census could scarcely do the country greater service than to collect, compile, and make easily available as complete descriptions as might be possible of every irrigating plant in the country. In none of the previous censuses has any information on this subject been gathered, for the reason, probably, that even at the last (1880) census irrigation had not become a very important national interest. It is already that. It is destined to become a controlling interest throughout half of our national area. The coming 1890 census should not fail to gather all the facts as to the present status of irrigation, whatever else it fails to do.

Owing to the fact that many of the States and Territories will not at their own expense collect and publish such data, or at least not for some time, the need of its being done by the eleventh census is still greater. The omission to give such information, in the tenth census, is keenly felt by all students of the irrigation question.

But the publication of the eleventh census is three or four years off, and there is need for immediate action on the part of each State or Territory having extensive irrigating works, whatever the National Government may do. Systematic records are an absolute necessity in order that each appropriator may be sure of his water rights. If capital is to be attracted to irrigating works, the best localities for operation must be readily ascertainable and the surety of a clear title held out. At best it is some time before returns are received from money spent in developing new ditches or in putting water on arid lands.

With irrigation development will come cheaper living expenses in the West, making a yet more attractive field for labor and capital in all industries. The whole West is now beginning to realize the conditions confronting it, and, doubtless, it will meet them with characteristic energy and promptitude. What is most needed just now is data, and it is hoped and believed that they will not long be wanting.

Canons and Railway Lines.

We present to our readers in this issue a series of photographic views of the interior of four of the canons of the Colorado which, as showing an almost unknown region, have an interest of their own quite apart from the immediate purpose of their presentation. The fine report of Capt. Dutton, U. S. A., below referred to, in the 1881 Report of the Geological Survey, contains many beautiful sketches of the region, but they seem to be only sketches, made by hand and not by the camera. The earlier report of Mayor J. W. Powell, who first explored these canons, also contained numerous sketches, but no photographs, we believe, and the sketches were largely made from higher points, so as to afford a more comprehensive view of the whole of the slopes of this gigantic chasm, which is a mile deep below the surrounding country. With the exception of Major Powell and his party, who went through the cañon twenty years ago, the party which lately went through it under Mr. Robert B. Stanton, Chief Engineer of the Denver, Colorado Canon & Pacific Railway, are the only persons who have ever made a continuous trip down these canons.

With these views we publish in another column an article of some length and no little interest from Mr. Stanton relating to the practicability of that canon for a railway line. We regret that it should have seemed necessary to make the article in some degree controversial, and no doubt the natural grief of the author for the untimely death by drowning in the canon of his friend and principal, President Frank M. Brown, makes it somewhat more so than it otherwise would have been; but into the controversial part of this discussion we need not follow the author, further than is necessary to make clear the technical situation.

The facts are these: Major Powell, soon after the war (1869), made the first and for nearly twenty years the only trip down the Colorado canon. Major Powell was and is a distinguished geologist and scientific man, but he was not and is not an engineer. He was going through a marvellous and unexplored canon, at great personal risk, and under circumstances calculated, if any ever were, to appal the imagination and confound the judgment. He was not thinking of any such wildly visionary notion (as it must then have appeared) as the construction of a railway through the canon, and was only anxious to reproduce in words the impressions of awful majesty which the gorge had produced upon him, and was likely to produce upon any intelligent observer. It is no discredit to him if in the effort to do this some of his statements prove to be in the literal sense exaggerated when subjected to the cold scrutiny of transit and camera. That they were so exaggerated Mr. Stanton seems to us to prove in his article published elsewhere, but we cannot and do not regard this as impugning the general accuracy of Major Powell's report *for the purpose for which it was intended.*

On the other hand, we must decline to accept the judgment of any layman, however distinguished as an explorer or scientist, as to the practicability of a railway line down that or any other canon, especially when his present judgment is based only on his recollections of twenty years ago. On the contrary, speaking from no little practical experience with canons and canon work, we feel bound to express our conviction that a canon of any kind, and more particularly a great canon, and still more particularly the greatest canon of the world, is the place of all places where the judgment of the layman on such a point is most likely to be absolutely at fault. More than in any other locality, the eye even of the engineer exaggerates the difficulty and underestimates the advantages of a canon route, and it is therefore often abandoned when it ought not to be. With the layman, this is naturally much more likely to be the case. In the presence of a majestic cliff rising a mile high in the air, the arm of man seems puny indeed: but yet the law of all such cañons, and not simply of this one, is that the difficulties are much less serious than they appear to the eye untrained in construction. The gorge which seems to have almost vertical sides is probably in reality as wide as it is deep. The rocky sides, which are unapproachable even by a mountain goat in their natural state, are much easier and cheaper to blast away for a roadbed than the long, deep thorough cut over which a man walks with ease, and hence with nothing to impress on his imagination the difficulty of the work he is judging of. Above all, the most expert observer in such a region can hardly bring himself to believe what is of course the fact, that the diffi-

culty of constructing a railway through a gorge is not a whit enhanced by its enormous depth, but that on the contrary it is only the lower hundred feet or two which counts at all; or, to speak more exactly, which counts unfavorably. The vast heights above lend grandeur and impressiveness to the route, but they do not affect one way or the other the mere details of construction, except as blocks may be liable to fall from above, an occasional, but not in the aggregate very important, contingency.

To see this more clearly: Imagine all the upper 5,000 ft. or so of the depth of the Colorado canon to be sheared off for several miles back, leaving the lower 200 ft. precisely as it now is. The mystery and impressiveness of the canon would then disappear, but the only way in which this would really affect the problem of constructing a railway there would be in diminishing the rapidity and volume of discharge from the lateral streams, which we will assume to be unaffected. Yet what sane engineer could then be made to believe that the bed of a large river, having the general characteristics shown in the lowest 200 ft. in height of our photographs (which are precisely what might be anticipated from the general character of the valley) was then "impracticable"? He might expect and admit that it would be a costly line, but he would undertake, with some confidence, to put a line down it which should compare well with other lines in rocky valleys; and Colorado and other experience has abundantly shown that these are not necessarily very costly, providing always that the water does not rise to excessive height, so as to keep the line too far above the river bottom.

In fact, the one statement in Major POWELL'S interview, quoted in another column, which carries legitimate weight in support of his declaration that the Colorado canon is "impracticable for a railway," is that as to the great rise of water in it, which he puts at 40 to 60 ft., Mr. STANTON increasing these figures to 40 to (at one point) 85 ft. Let us see what difficulties are legitimately implied by these admitted facts.

The general nature of all canons, even the worst of them, is that they alternate between short stretches of canon proper, where the channel is narrow and crooked and the banks rugged and abrupt, and longer stretches of much more open country, wide channels, and smoother slopes. To this law there is practically no exception in any part of the world. And it results further, from evident natural causes, that, other things being equal, the larger the stream, the more direct will be its course; the wider its bottoms, the smoother and more abraded its slopes, and the fewer its short, abrupt turns, too sharp for a railway line to follow.

At the normal stage of water, we do not hesitate to say that there is not a canon in the world which does not afford dry footing on the side for fully three-fourths of its length. At the higher stages the narrow gorges act as dams or contracted rivers, backing up the waters to a great height through the gorges, but from the very nature of the case forming a comparatively still and level lake above, since the cross section is there so great as to require no great velocity to give the required discharge. Accordingly, the great rise of water is confined to short distances of the worst of the true canon, and over the remainder of the distance the rise of water in the worst canon is comparatively moderate, and is accurately indicated by the level of the broad or narrow strip of bottom, where there is any, the rule being that the bottoms are slightly above the ordinary high water, but somewhat below what may be expected at intervals of ten or twenty years. It is then optional whether to place the tracks along the surface of this bottom, and permit them to be overflowed at rare intervals, or to place them high enough above it to miss overflow altogether at the cost of heavier work. As a rule, the former course is the more truly economical, since it really matters little if the track is under water for a few days in exceptional years, or even every year, many of our best roads having sections of this kind. In the canon proper, it is of course necessary to be above high water, but then, in that locality, the expense is not greatly more of keeping high than low.

The one saving fact which makes cañon work so much less costly than appears to the untrained eye is this: Nature has made the fills. Accordingly, we are not obliged to make heavy cuts or tunnels to reduce the height of successive deep gorges, but can touch the projecting points lightly, secure in the fact that we do not increase the height of our fills or bridge work by so doing. Moreover, just where construction would otherwise be more difficult, in the canons proper, we have abundance of rock on which to found our roadbed, or to make a fill, at some bend of the channel, which will not wash away. Of course, such heavy canon work costs money, and the line even as a whole may be expensive; but it is not necessarily or usually prohibitively expensive.

On the other hand, such a canon usually furnishes a most favorable line for a railway, giving low grades for freight transportation, and a most attractive route for passengers, because of the grandeur of the scenery. The Grand cañon of the Colorado seems to be particularly favorable in respect to gradients, erosion having been so uniform that "the maximum slope of the main stream (reckoned throughout any stretch exceeding four or five miles) never exceeds 25 ft. per mile,"* the average fall of the river being 7½ ft. per mile, distributed with remarkable uniformity, shown in the table quoted by Mr. STANTON. As for the possible attractions of the route to passenger travel, let us hear what Captain DUTTON says about it:†

> Those who have long and carefully studied the Grand canon of the Colorado *do not hesitate for a moment to pronounce it by far the most sublime of all earthly spectacles.* If its sublimity consisted only in its dimensions, it could be sufficiently set forth in a single sentence. It is more than 200 miles long, from 2 to 5 miles wide, and from 5,000 to 6000 ft. deep. There are in the world valleys which are longer, and a few which are deeper. There are valleys flanked by summits loftier than the palisades of Kaibab. *Still, the Grand canon is the sublimest thing on earth.* It is so, not alone by virtue of its magnitudes, but by virtue of the whole- its *ensemble.*

The italics are our own; but if this be true—and there is abundant reason to believe it is true—what is likely to be the attractiveness of such a route for passenger travel? To form some estimate of it: Niagara also has been called the most sublime of earthly spectacles. What would a *monopoly* of access to Niagara Falls be worth to a railway, that is to say, to a railway so situated that access to the falls could only be had by riding over it for 500 or 600 miles? Making all allowances for differences of conditions, but remembering that the great West is developing fast, as also the pleasure travel across the continent, it is plain that this is a consideration not to be ignored.

Now, referring to the map of the Pacific Coast railway systems which appeared in our issue of Sept. 7, any one can study for himself the relation of a railway line down this canon to the other railways of the region, and he will see that the probable passenger travel over a line of this character, continuing, as it would also, the attractions of the Colorado railways already built, would be likely to be very great indeed, quite enough to pay interest on a considerable extra cost for construction. He will also see that it furnishes, in connection with the Denver & Rio Grandé Railway, a low-grade line between the Pacific coast and the Mississippi valley via the Royal Gorge of the Arkansas and the Marshall Pass, that being the only summit to be passed over. If he chance to be able to refer to a fine "Hypsometric Map of the United States," at page liii. of the population volume of the 1880 U. S. census, he will see at a glance how significant is the contrast between this and any other possible route in elevations passed over, and how favorable a natural outlet the route affords for the mining and other products of Colorado, Utah, Wyoming, and northern Arizona. He may perhaps also be led to the reflection that when the Nicaragua canal is finished, the advantages of the route will be still more conspicuous in this respect; and altogether, we think he cannot but conclude that a certain considerable excess of cost per mile can well be afforded; while if he be an engineer, and studies the faithfully reproduced views given in this issue, we do not think he will be led to the conclusion that this excess of cost need necessarily be very great.

We have been thus particular in rehearsing engineering and other facts in relation to canons in general and this canon in particular, not that we have the slightest personal interest in the project or in those backing it. They are personally unknown to us, and we have not conferred with them. But we have felt that it was due to those undertaking a great project in a region well described by Capt. DUTTON as one "which at first bewilders and at length overpowers" that they should not be impeded by imaginary as well as real obstacles. We are compelled to challenge the competency of any one but an expert engineer to form even a valuable impression as to the feasibility of such a route for a railway line. It may be that to build the line will cost more than it is worth: as to that, we have no opinion to express. That the line is "impracticable" in any sense, or even what engineers would call a seriously difficult line, we do not for a moment believe. For example, the construction of the Canadian Pacific Railway through the Frazer canon was probably a far more difficult task than this will prove to be, both because that river also rises enormously, and because the rock was in inclined strata, much shattered, and largely wanting altogether at the most difficult points, so that the road-bed had to be constructed on dry gravel slopes, already at the angle of repose, and extending upwards from the river for hundreds and even thousands or more feet. That is the kind of country which the engineer is disposed to give up in despair when he has to keep one or two hundred feet above low water,—not the solid rock bluffs which look so forbidding to the amateur.

*"The Physical Geology of the Grand Cañon District." By Capt. CLARENCE E. DUTTON, Ordnance Corps, U. S. A. Rept. U. S. Geol. Survey, 1881, p. 160.

†Same report, p. 144.

CORRESPONDENCE.

Portal Bracing Formulae.

CHAPEL HILL, N. C., Sept. 10, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In an article on portal bracing published in your issue of July 13, there is the obvious error in the reduction of one of the formulas and the bending moment consequent thereon, as pointed out by Mr. J. W. PEARL in your issue of Sept. 7. I had noticed it before, but thought it scarcely worth while to correct what was so apparent.

I will take this opportunity, though, to note in reference to the article of July 13, page 27, for the case of the end

posts being "fixed" at the lower ends, so that the tangent to the elastic curve there is vertical, that it is plainly an *assumption* to consider the tangents vertical at the points C and D (Figs. 1 and 3), so that the formulæ for this case may differ more or less from the truth.

The complete solution of structure involving a combination of pieces acting as tees, struts, and beams can be effected by a method dependent on the principle of "least work" and largely developed by CASTIGLIANO in his "Systèmes Elastiques." I hope some time to present my notes on the subject to the profession.

As concerns portal bracing, it is a question whether the lower ends of the posts can be regarded as "fixed" by the pins there, as there is necessarily some play.

In case of doubt, the formulæ for the lower ends of the posts free to turn (which are absolutely correct for that case) may be used, or possibly a mean of the results given by the two methods may be regarded as more satisfactory.

Yours truly.

WM. CAIN.

The Massachusetts Institute of Technology Degrees.

Department of Civil Eng., Mass. Institute of Technology,
BOSTON, Mass., Sept. 17, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I trust that you will give me space to call attention to the erroneous impression conveyed by the editorial in your last issue regarding the new course on Sanitary Engineering at the Massachusetts Institute of Technology, touching the matter of the degrees conferred by this Institute.

After "presuming" that the new course leads to the degree "S. E.," you proceed, on this basis, to criticise the propriety of granting this degree, or similar degrees, on the ground that a school cannot make a man an "engineer." Your inaccuracy is the more remarkable from the fact that this view is precisely the one which has always been taken by the Faculty of this Institute.

The fact is, as a reference to the catalogue would have shown, that this school has never granted to undergraduate students any degree but that of Bachelor of Science (S. B.). It does not, and never has, conferred the degrees of C. E. or M. E., and it will not confer that of S. E. Its Faculty has always held (and I am glad to find that you agree with it) that no collegiate training alone can make a young man an engineer, in the true and proper sense of the term. Consistently following this view, this Institute does not confer the degrees C. E. or M. E. even for post-graduate work, its post-graduate degrees being Master of Science, Doctor of Philosophy, and Doctor of Science. In fact, the letters C. E. after a man's name can nowadays be taken, without further knowledge, to mean nothing more than the title Civil Engineer, being assumed indiscriminately by almost everyone who practices as an engineer, and by many who have no knowledge of any branch of engineering except surveying.

Your remarks regarding the propriety of differentiating the courses of study in our engineering schools, however, afford some ground for criticism. Time was when a man could be at once a civil and mechanical engineer and architect; but engineering has advanced some since then, and a young man must now make up his mind to pursue a much narrower line of work. If he cannot decide whether he wants to be a civil or a mechanical engineer, it is no fault of the school which offers him courses in these two directions; and a glance at the catalogues of our best engineering schools will show that the courses in civil, mining, or mechanical engineering differ far more than, as you suggest, would be represented by "two or three months' steady work by the maturer mind."

Between civil and sanitary engineering, however, the gap is much smaller, for the sanitary engineer must be essentially a civil engineer. I may call attention to the fact, however, which is often lost sight of, that it is not simply the knowledge a young man gets in his technical course which is of benefit to him in his future career, but even more the training, and the habits and direction of thought which he acquires. It is this point of view which has appeared to us to render it advisable to lay out a new course, which while preserving essentially the engineering instruction which is and has for years been regularly given to students in civil engineering, shall yet, by an omission or curtailment here and there, provide for very moderate but continuous courses in chemistery and biology. The engineer who devotes himself to sanitary work is being brought, in a constantly increasing degree, face to face with problems requiring the aid of the chemist and biologist, and he should be to a certain extent familiar with their methods and able to understand their results. And although some men are able, in mature years, to take up and gain a mastery of new subjects, the busy engineer seldom does, and it is much more difficult for him to do so than if he had received some systematic preliminary training in them. The sanitary engineer should not and cannot be a chemist or a biologist. He may and probably will forget many of the facts he has learned about chemistry or biology in his course in sanitary engineering. But if the training he has gone through has taught him to look at some things from the chemical or biological point of view,—to think of them in chemical or biological language—he will be in that respect much better equipped to deal with questions of the public health.

Yours truly.

GEORGE F. SWAIN,
Professor of Civil Engineering.

[We have elsewhere made our apologies to the Massachusetts Institute of Technology for having spoken on the prevalent loose conferring of degrees of "C. E.," "M. E.," etc., in connection with almost the only prominent college which is *not* guilty of this—we hold—improper practice. It arose simply from the fact that we happened to know of several graduates of the Institute who do, in fact, append the initials C. E. to their names, and the custom is so all but universal that our attention had not been called to the fact that the M. I. T. was an exception. As to the general question of to what extent it is judicious to differentiate a four years' course into specialties, it is too large a question to discuss here. We observe that the M. I. T. courses are more differentiated than some others, but we still hold to the view that "two or three months' work of the maturer mind," will put the *graduate* M. E. of that Institute on a level with his C. E. brother for the practice of civil engineering, and on more than a level in one respect, that he will know something about steam engineering and thermo- and other dynamics, without a pretty good knowledge of which the civil engineer is at no slight disadvantage. We do not suppose it would be a popular course for a college to take, but we believe that better all-around results would be obtained if the specialization only occurred after four years of general study. For example: What civil engineer is well equipped for his professional career nowadays without some knowledge of electricity? Yet we do not find it in M. I. T. curriculum for C. E. study, even among the options.—ED. ENG. NEWS.]

The Julien Electric Cars on Fourth Ave.—Correction.

NEW YORK, Sept. 12, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

We are informed that an article appeared in your issue not long since, to the effect that the Fourth Ave. road is being operated by the "Sprague" system. This is undoubtedly a typographical error as it is well-known that the Julien system of storage batteries is there operated and not the overhead system of the Sprague Company. Hoping that you will see fit to correct this error, we remain.

Very truly yours,
THE JULIEN ELECTRIC TRACTION CO.

[The error was due to a slip of the pen, and we with pleasure make the correction. We may add that the Julien Co. seems to be making a very promising record on Fourth Ave.—ED. ENG. NEWS.]

A Turbine Problem.

FRASERVILLE, Que. Sept. 14, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Mr. J. A. GILLESPIE, C. E., asks in your issue of Aug. 24: "What will be the net horse power through a single turbine, head 800 ft. diameter of supply pipe 20 ins.?" You replied about 32,000 H. P., assuming a flow of about 480 cu. ft. per second. This is very much in error. Your 480 cu. ft. per second is about all the water that could possibly escape through a 20-in. pipe under 800 ft. head with free discharge.

Assuming the usual safe allowance of 4 ft. per second as the velocity of water in the pipe, which gives us a flow of 8.11 cu. ft. per second we would get through a single turbine at 80% efficiency 587 H. P.

As the circumferential velocity of the turbine would be about 180 ft. per second or for a 10-in. wheel 4,080 revolutions per minute, it would be almost impossible to render such a machine workable. If it is contemplated to utilize any such enormous head it would be wise to adopt a pressure engine. For a description see Weisbach, Vol. II. Du Bois, Am. ed.

Yours truly, M. J. BUTLER.

[Our correspondent will pardon us for saying that we do not see the error. The problem was "net horse-power through a single turbine, head 800 ft., diameter of pipe 20 ins." We know of no such "usual safe allowance" as 4 ft. per second for the velocity of water in the pipe. As it corresponds to no more than 3 ins. head, we do not believe any such rule exists. The 32,000 H. P. given by us is not anywhere near the full theoretical H. P. under the given conditions, for if our correspondent will figure it up he will find that, "not taking pipe friction into account," as we expressly provided, it amounts to 44,840 H. P., as follows:

$$\frac{\pi 10^2}{144} \times \frac{8.02\sqrt{800} \times 60 \times 62\tfrac{1}{2} \times 800}{33{,}000} = 44{,}840$$

The stated 32,000 H. P. is only 71⅓ per cent. of the theoretical H. P. There are plenty of makers who would undertake to furnish about that H. P. from the assumed head and discharge by *modified* turbines adopted to the enormous head, after sufficient experiments. We do not suppose such wheels are to be picked up in the market from stock, but even such would give ten or more times the H. P. that our correspondent computes. No doubt some other hydraulic engine would be best for so great a head,—we have one such on hand for illustration next week; but that was not the question.—ED. ENG. NEWS.]

The Abt Rack-Rail System on the Transandine Railway.

It is gratifying to note the progress which the Transandine Railway is making, due chiefly to the energy with which Messrs. J. E. & M. Clark & Co. are prosecuting the last and most difficult part of the work. The Andes are being crossed at the Uspallata or Cumbre Pass, where there will be a tunnel 3.1 miles in length, at an elevation of 10,450 ft. above sea level. The pass itself is nearly 3,000 ft higher, or at 13,015 ft., and is situated 4½ miles south of Aconcagua and 3.84 miles north of Tupungato, in 33° south latitude. It will thus be seen that the summit level of the Transandine Railway is far above any European lines, which at the Rigi reach to 5,753 ft., and at the St. Gothard, 3,788 ft. The total distance from Buenos Ayres to Valparaiso is about 871 miles, and railway construction has been going on for nearly twenty years. At the Atlantic end 640 miles of line are complete, while at the Pacific end 82 miles are laid, leaving 149 to be built. The gauge is not uniform. From Buenos Ayres to Mendoza it is 5 ft. 6 ins., 426 miles being worked by the Buenos Ayres & Pacific Railway Co., and 213 miles by the Great Western Railway Co. From Valparaiso to Santa Rosa the gauge is 4 ft. 8½ ins. The remaining link from Mendoza to Santa Rosa is now being built on the metre gauge by the Buenos Ayres & Valparaiso Transandine Railway Co. The first 56 miles are nearly completed, the rails being laid for 40 miles. According to the *Zeitung des Vereins Deutscher Eisenbahn-Verwaltungen*, an alteration of route has been made in the remaining part, and the ruling grade of about 1 in 25 has been abandoned. This change has been dictated by the adoption of the Abt system of combined adhesion and rack-rail traction. The grades are now to be 1 in 40 in the adhesion sections and 1 in 12½ upon the rack sections. The rack rail will consist of three rack bars, as at the Hartz Railway, and the order for it has already been placed with Messrs. Rinecker, Abt & Co., of Wurzburg.—*Engineering.*

THE WORLD'S STEAM POWER.—According to a recent publication of the Statistical Bureau at Berlin, four-fifths of the steam machinery in the world has been constructed within the last 25 years. France has 49,500 stationary boilers, 7,000 locomotives, and 1,700 ship boilers; Austro-Hungary, 12,000 stationary boilers, and 2,400 locomotives. In the United States the steam machinery, exclusive of locomotives, has 7,500,000 H. P.; in Great Britain, 7,000,000 H. P.; Germany, 4,500,000 H. P.; in France, 3,000,000 H. P.; and in Austro-Hungary, 1,500,000 H. P. There are some 105,000 locomotives in the world, of which 29,398 are in the United States. The American statistics of stationary steam power must of necessity be very incorrect, and are much more likely to err by omission than otherwise, so that we have no doubt that our lead in steam power is somewhat greater than the above indicates.

IT is proposed to erect a monument to the late JAS. B. EADS, in St. Louis, at a cost of $25,000, the monument to consist chiefly of a fine full length statue of Capt. EADS.

Accidents on British Railways in 1888.

The annual report to the British Board of Trade on the accidents which occurred on the railways of the United Kingdom during 1888 shows a total of 905 persons killed and 3,826 persons injured during the year from all causes connected with the working of railways.

These totals are divided as follows:

	Killed.	Per cent. of total killed.	Injured.	Per cent. of total injured.
Railway employés,	396	44	2,193	57
Passengers on trains	107	12	1,408	37
Trespassers on right-of-way	230	25	114	3
Suicides	65	7	—	—
On grade crossings.	53	6	24	1
Miscellaneous causes	54	6	87	2
Total	905	100	3,826	100

It is interesting to compare this report with the similar statistics for the State of Massachusetts. The accidents reported to the Board of Railroad Commissioners of that State during the year ending Sept. 30, 1888, caused the following injuries and fatalities:

	Killed.	Per cent. of total killed.	Injured.	Per cent. of total injured.
Railway employés,	80	32	311	58
Passengers on trains	18	7	99	19
Trespassers on right of way	114	45	82	15
Suicides	4	2	—	—
On grade crossings.	27	11	32	6
At stations	7	3	12	2
Total...	250	100	538	100

The greatest apparent differences in the above table are in the items of trespassers and grade-crossing fatalities. This is as might be expected, in view of the small number of grade-crossings in England, and the precautions taken there to keep trespassers off the right of way. The only remarkable feature is that the proportion of accidents from these causes in Great Britain should still be so large. The fact that suicides form 7 per cent. of British railway fatailties, while in Massachusetts they are but 2 per cent. of the whole, might be made the subject of an interesting social and psychological study.

The total number of passengers killed and injured from all causes was, as stated above, 107 killed; 1,408 injured. Of these, however, only 11 were killed and 594 were injured from causes beyond their own control. The total number of passenger journeys, exclusive of those of season-ticket holders, was 742,830,000. Thus one passenger in each 6,942,336 was killed, and one in each 527,577 was injured. Those killed and injured from causes beyond their own control were one killed in each 67,530,000 and one injured in each 1,250,555.

To show the progress made in Great Britain in the direction of greater safety in railway travel we have compiled the following table, showing the average annual figures for each 5-year period since 1873.

Accidents and Injuries to Passengers on British Railways for 15 years.

Average per year in the 5 years	No. of passengers killed and injured (from causes beyond their own control) from accidents to trains.		No. of passenger journeys (exclusive of journeys by season-ticket holders)	Proportion killed and injured (from causes beyond their own control) to total carried	
	Killed	Injured		Killed	Injured
1874 to 1878.	35.2	1,188	527,944,250	1 in 24,658,274	1 in 489,502
1879 to 1883.	31.2*	702	625,466,869	1 in 30,782,645	1 in 816,287
1884 to 1888.	16.2	609	718,857,856	1 in 65,230,222	1 in 1,239,513

* The 73 persons lost in the Tay bridge disaster in 1879 formed nearly half the fatalities of this 5-year period.

The facts shown by this table are remarkable. If we are ever accustomed to think of British railways as unprogressive, that impression will be a little shaken when we understand that a passenger taking a journey on a British railway to-day stands hardly one-third the risk of being killed or injured that he did a dozen years ago. This is shown most conclusively by the above table; for, by taking the average of 5 years, the variations in successive years, due to the accidents of great fatality, are nearly eliminated.

It would be most interesting to compare similar statistics for the United States, were any in existence, and it would be most comforting if we could know we had made progress in this country during the past dozen years at least equal to that made by our British cousins. Some comparison of the relative safety of railway travel here and in England may be made by use of the statistics of the *Railroad Gazette*, showing the annual casualties from train accidents in the United States. These are as follows for the past 5 years:

	Passengers on trains.	
	Killed.	Injured.
1884	89	1,016
1885	85	617
1886	132	736
1887	207	916
1888	168	1,012
Average	136	859

It seems entirely safe to consider that all these fatalities and injuries were from causes beyond the passengers' control, as they all occurred in train accidents. Moreover, the *Gazette's* records, being made up from newspaper reports, err on the side of omission, especially as regards the number of injuries. This is, of course, the reason for the apparent fatality of American accidents. It would be an erroneous conclusion therefore that train accidents in this country are more deadly than in England, or that the English traveller in a smashup is any more prone to claim personal injuries and a right to damages than an American.

In order to compare now the American fatalities with the British, we need to know the annual passenger mileage of the two countries. This is shown in the following table, in which we have obtained the British passenger mileage by taking the reported number of passenger journeys and multiplying by 8, their estimated average length. The figures for the United States are from "Poor's Manual."

	Total passenger mileage.	
	Great Britain	United States.
1884	5,559,934,880	8,778,581,061
1885	5,577,704,248	9,133,673,956
1886	5,804,675,120	9,659,698,294
1887	5,869,360,000	10,570,306,710
1888	5,942,640,000	11,100,613,679
Average	5,750,862,849	9,866,574,740

Now from the summary of that table and the preceding, it appears that in Great Britain, during the past 5 years, one passenger has been killed in each 354,991,533 miles travelled; and one has been injured in each 9,443,124 miles travelled. In the United States during 5 years past, one passenger has been killed in each 72,548,343 miles travelled; while one has been injured in each 11,486,117 persons carried.

As already stated, however, the greater apparent immunity from injuries in this country is due to incorrect statistics and does not in fact exist. The true comparison is by deaths, and even this is much too favorable to us, because of omissions.

During the year, 61 train accidents were investigated by order of the Board of Trade. Of these, 4 resulted fatally to passengers. The most serious of these was on the Manchester, Sheffield & Lincolnshire, and was caused by the breakage of an axle. Four passengers were killed and 14 others were injured. The investigation of this accident showed that its fatal consequences would probably have been averted if the train had been supplied with an automatic brake under the guard's control, or if there had been means of communication between the passengers and the engine driver or guard.

It is noticeable that the working of the train brakes is especially commented upon in discussing the various accidents. Of the 7 accidents resulting from trains entering stations at too great speed, it is said that one accident might have been avoided had there been a continuous brake on the train; that in another, the automatic action of the vacuum brake prevented any rebound or consequent injury to the passengers; and that in a third, the non-automatic vacuum brake failed to act on the connecting pipe becoming detached, which could not have occurred had the brake been automatic. Another point to which the inspectors have paid special attention is the length of time the employés concerned in an accident had been on duty at the time the accident occurred.

The list of accidents to employés shows injuries and fatalities from the following causes:

	Killed.	*Injured*
Coupling or uncoupling cars	15	258
In various shunting operations	84	1,063
Caught between vehicles	19	81
Falling between train and platform	13	37
While working on track	66	67
Walking, crossing, or standing on line	98	131
Total	295	1,577

To show the advance which has been made in securing the safety of employés since 1874, we have compiled the following table.

By this it will be seen that the average British railway employé stands hardly half the risk of being killed or injured that he did a dozen years ago. We doubt whether the United States can show any general decrease in the proportion of casualties to employés to the total number employed. The introduction of automatic brakes and couplers will help our record enormously, but we do not see much prospect of increased safety to employés in any other direction.

Casualties to British Railway Employés during 15 years.

Average per year for the five years.	By train accidents.		By accidents on railways exclusive of train accidents.		Total number employed.*	Proportion of accidents to employés, by train and other accidents, to whole number employed.*	
	Killed.	Injured.	Killed.	Injured.		Killed.	Injured.
1874-1878	26.4	211	656	2,429	260,000	1 in 391	1 in 103
1879-1883	16.4	129	509	2,174	305,000	1 in 578	1 in 132
1884-1888	11	96	437	2,047	346,426	1 in 782	1 in 162

*The numbers employed are known accurately only for the years 1874 and 1884. The other years were estimated from that, hence the last three columns are only approximations to the actual.

A half page of the report is devoted to the progress made in the introduction of the absolute block and interlocking systems. The proportion in which the signal and switch levers have been interlocked is 93.5 per cent. in England, 82 per cent. in Scotland, 59 per cent. in Ireland, and 90 per cent. for the United Kingdom, the last figure showing an increase of 1 per cent. during the year, most of which has been in Ireland and Scotland.

In 1873, out of a total of 16,082 miles, 6,217 miles were worked on the block system. In 1888 this system had been adopted on 15,036 miles out of a total of 18,687 miles open for traffic. On single-track lines, the train staff system has in recent years been required to be used in conjunction with the absolute block, and the length so worked now amounts to 4,847 miles; 484 miles are worked on the single engine system, 388 miles on the train tablet system, 26 miles by permissive block, 160 miles by train staff and telegraph combined, and 2,330 miles by train staff.

The continuous brake returns showed the number of vehicles fitted with brakes complying with some or all the conditions of the law to be 77 per cent. of the whole number in use; while the number fitted with pipes and connections only were 15 per cent. more.

THE MOST POWERFUL ROLLING-MILL engines in the world, according to the *English Mechanic*, are the reversing engines just made by Galloways, of Manchester for Palmer's Ship-Building Co. The engines drive a 44-in. train of rolls. The cylinders are 56 ins. diameter and 6 ft. stroke, and use steam at a pressure of 100 lbs. The engine is fitted with Joy's valve-gear. The crank shaft is built up of mild Siemens-Martin steel, the forgings of which weighed over 41 tons before being turned. The finished shaft has journals 21 ins. diameters, and is of a total length of 23 ft. 6 ins. The total weight of the engines is nearly 300 tons.

An Active Defence of Cedar-Block Pavements.

While one of the editors of this journal was in the city of Toronto recently, his attention was attracted by a huge 4-horse float, at least 30 ft. in length, on which was mounted a long **A** shaped frame, the sides of which were covered with cedar blocks. The course of this unique vehicle was heralded by the beating of a drum, and the reason for its perambulation of the streets was given by liberal distribution of the following circular:

TO THE CITIZENS OF TORONTO.

An Appeal against a Flagrant Injustice.

The Cedar blocks on this platform are those taken out of Spadina Road pavement by Assistant City Engineer Cunningham. In consequence of his report that ONE SIXTH WERE BAD WE WERE

"BLACK-LISTED."

PLEASE EXAMINE THEM, and IF YOU FIND THEM BAD, CONDEMN US. But if otherwise then SUPPORT US in our Fight against the Asphalt Paving Ring formed on the American Municipal Principle to fleece Toronto for the benefit of a Foreign Company.

We are not the owners of a Public Newspaper, neither are we of sufficient wealth to present to you through the medium of the Public Press the history of a job which must outrage the feelings of any one who believes that Canada is for the Canadian, and in all cases where a Native and a Foreign Firm are in competition, the former should be supported when the value given is the same. But GENTLEMEN, not only does the American get the Sherbourne Street contract, but we are hounded to the ground because we have asserted our manhood and dared to enter into competition against them.

Mr. Warren, of the American Company, stated in the Parlor Car "Clifton," at Hamilton, last Sunday evening "that Municipal Contracts were never got on their merits, but had to be purchased." Can he refer to Toronto and his Contracts here? If so, this will explain the motives actuating the advocates of the Foreign Company.

In attacking our work on August 17th, the *Telegram* stated, "The Spadina Road Cedar is a hundred per cent. worse than the College St. Blocks;" you have before you the blocks from Spadina Road. Judge for yourselves whether the College St. Pavement was of the character that the *Telegram* represented it last Fall.

If the desire is that no competition should be offered on Asphalt Pavement, let it be so declared, that the Public may know what they are doing.

Was it that these Blocks were bad, that they were condemned, or

BECAUSE WE WERE DANGEROUS RIVALS OF THE AMERICAN ASPHALT COMPANY?

We are, respectfully,
E. & C. FARQUHAR.

The blocks which were so pugnaciously defended were not "one-sixth bad" by any means, although a few of them were rather tender. The whole proceeding impressed our representative as a most amusing method of appealing to public opinion; and it subjected the professional opinion of the city engineer to a wholesale public verification in a unique way. We cannot undertake to say which of the parties to the present controversy was in the right, although in general we are of the opinion that a good asphalt pavement is greatly preferable to one of cedar blocks. One most amusing point in the above circular, to readers on this side of the border at least, is the reference to the "paving ring formed on the American Municipal Principle." The author of the circular has evidently travelled in the United States.

THE CROSSNESS OUTFALL SEWAGE PRECIPITATION Works, London, designed to deal with the sewage from a future population of 2,400,000, is thus described in a late number of *Engineering*:

The sewage is carried to the works by a barrel sewer 11 ft. 6 ins. in diameter, and on reaching Crossness is pumped into an existing reservoir, which covers seven acres of ground, and is capable of holding 4,000,000 cu. ft. of sewage, which can be stored for about eight hours per tide, and discharged at high water. The works now being carried out are for the treating of the sewage by precipitation, and they comprise the adaptation of four compartments of the old reservoir to the process, and the construction of a new one with an area of 2¾ acres, and capable of holding 1,000,000 cu. ft. of sewage. Before entering the precipitation tanks, the sewage will be treated with lime water and iron water, and afterwards allowed to rest two hours in the tanks, during which the solids will be precipitated. The supernatant liquor will then be decanted off over weirs, and thus separated from the sludge. This sludge is afterwards to be mechanically swept off the floors of the tanks into a sump or well, whence it will be pumped into another reservoir, where a further precipitation will take place. The effluent from the second set of tanks will be used in making the lime water for treating a further portion of the sewage, and the sludge will be discharged into specially constructed vessels which are to carry it out to sea and deposit it there.

UNDERGROUND WIRES have a greater extent in Chicago than in any other American city. About 6,000 miles have been buried, and where a good quality of material has been used the result is said to be perfectly satisfactory. City Electrician J. P. BARRETT states that the maintenance on an underground line is but 2 per cent. as much as when strung on poles.

The 6,000 miles of underground wire is carried in 170 miles of 2 and 3-in. pipe. The underground system is practically complete on the south side from the river to Twelfth street. In that district the only aerial wires are a few along the railway tracks. The close of the year will see all north side wires underground as far north as Division street. On the west side about everything between Ashland avenue and the river will be under. Dealing with the electric light companies has been an easy matter, as they never had an ordinance permitting the use of overhead wires. All the electric light wires, therefore, have been laid underground in the first place.

THE LINOTYPE COMPOSING MACHINE described in our issue of May 25, 1889, is to be introduced in England. A company has been formed there to manufacture it and has purchased the English patents for $2,500,000 in the company's stock.

Paper as a Roofing Material.

The engineer or contractor who has charge of the construction of a building in which economy is an important consideration, and in which a considerable area of roofing is required, has always a problem before him in choosing the material for his roofing. Shingles are quite cheap and will last from 10 to 50 years, though at the end of the longer period not much will be left of the four inches that was originally exposed to the weather. On the other hand, they are quite inflammable at the start and grow more so as they grow older; they cannot be laid on roofs of low pitch; any great amount of travel over them by workmen will cause leaks; driving storms are apt to go through them, and they are fast growing more expensive, especially the better grades.

A tin roof is more expensive than shingles, and will last in good condition about as long. It must be painted once in two or three years. It is the hottest of all roofs in summer weather, and the boots of linemen traveling over it are quite apt to puncture holes where water will enter at the next storm.

The numberless forms of tar composition roofing are of very various merits and costs. The inherent trouble with them all is that in the extreme heat of our summer the tar is apt to run out or lose its more volatile constituents by evaporation, so that it will crack or crumble in cold weather. From one cause or another it seems generally the mission of tar roofs to leak, and their mending is generally an uncertain and patience-destroying process.

There is another class of buildings in which the problem of roofing is often very unsatisfactorily solved. We refer to the temporary structures intended for use for from three months to perhaps four or five years, put up to shelter workmen or teams, store tools, explosives, etc., while work is in progress on any contract of considerable size. These shanties are generally knocked together in the roughest way and from whatever material is cheapest and most convenient. Boards with cleats over the cracks commonly form the roof, though the ordinary tar felt sheathing paper is often used.

It was with the idea of replacing this latter easily soaked material with something more nearly waterproof, for use on temporary buildings only, that one of the editors of this journal recently examined some samples of the waterproof roofing and sheathing papers put on the market by F. W. Bird & Son, of East Walpole, Mass. An examination and series of tests of these papers, however, has convinced him that the better grades of these papers make a permanent roofing of very great merit and one which will well repay a trial by contractors and engineers.

The problem of making a waterproof paper is no easy one. As every one knows, in the process of paper manufacture, the fibers composing the paper are held in suspension in water, and to make the finished sheet so compact and wet-proof that the fibers shall not be released from each other again when subject to the action of water, is a difficult task.

The tests which we have made refer only to the strength of the paper to resist tearing and abrasion, both when wet and dry, and to its waterproof qualities. Of course the test of long usage exposed to all the various conditions of extreme heat and cold, ice, sleet, hail, freezing, and thawing, form a test which cannot be satisfactorily duplicated by artificial means.

There are three grades of this paper put on the market, and their retail price is about as follows:

No. 1 "Neponset" rope roofing, per 100 sq. ft.	$1.00
No. 2 "Neponset" rope roofing " "	.55
Black "Neponset" building " "	.35

The regular market size is put up in rolls 36 ins. wide, containing 500 sq. ft. or 250 sq. ft., but other widths are made to order. With the No. 1 and 2 are put up tins and galvanized iron nails for fastening the paper.

The rope roofing fabrics, Nos. 1 and 2, are about the color of sole leather. The principal stock used in their manufacture is old rope, hemp or manila, and this long fiber gives a paper of remarkable strength. No. 1 weighs about 8½ lbs. per 100 sq. ft. The tensile strength of a strip 1 inch wide, we have roughly determined to be about 75 lbs. The same strip, after soaking in water for three days, sustains about 10 lbs. When only one side is exposed to the water, as is the case on a roof, the loss of tensile strength is much less. The waterproofing extends through each layer, and is not a surface skin on the paper, so that slight abrasion does not affect the resistance of the paper to water. To test the waterproof qualities of the paper, vessels of various forms, involving in some instances a double fold of the paper, were made and filled with water; and were also exposed to rain and filled with water after both sides had been wetted and dried. All these tests failed to show any passage of water through the paper; and the side opposite to the water was not perceptibly damp. In one test the writer made a saucer-shaped dish of the paper and let water remain in it for 24 hours. At the end of that time the opposite side of the paper was still so dry that a match was lighted on it, notwithstanding the fact that the conditions were most unfavorable to any drying away of the water, had any soaked through from the other side. Very much the same results as regards resistance to water were shown by the No. 2 paper, which differs from No. 1 chiefly in being considerably thinner. The black "Neponset" is intended by the makers principally for use as a sheathing paper. It is made of a cheaper stock than the rope paper and is lighter in weight. Our tests showed a tensile strength of about 28 lbs. when dry, and about ½ lb. when wet, per inch in width. This sample did not show as satisfactory results when tested for waterproof qualities, but another sample of the black, afterward tested, was practically as impervious to water as the rope papers. The black paper does not seem to be of so uniform quality as the rope papers, and is made, of course, from much cheaper stock.

These various styles of paper are as much cheaper in cost of application than other kinds of roofing as they are in first cost of material. The preferable mode of application is to lay the widths of paper parallel to the eaves and overlap each width about one or two inches. Wooden strips about ½ in. by 1 in. are then nailed on, running from the ridge to the eaves, and about 8 ins. apart. Each exposed edge of the paper is then fastened by a row of galvanized nails driven through dome-shaped tins. Of course, for a temporary roof, the fastenings may be as much simpler and cheaper as desired. In case the roofing should be broken at any point, it can be patched with a piece of the paper nailed on, making a tight joint with paint or red lead; or a new width can be put in with little trouble.

While the manufacturers only recommend the black paper as a sheathing paper, and say explicitly that they do not wish it used for roofing, we are of

the opinion that for many of the cheap structures put up by contractors it will answer quite well for a roof; it will certainly prove much better than the commonly used tarred-felt. The No. 1 paper, as permanent roofing for many classes of buildings, is certainly far cheaper than anything else in use. We are informed that the factories and storehouses of F. W. Bird & Son, at East Walpole, Mass., are covered, roof and sides, with this paper, which has now been in service there about five years, with the most satisfactory results.

The most serious defect of these papers lies in the fact that the composition which is used to render them waterproof makes them quite inflammable. There are of course very many buildings so located that this consideration will have little weight. For places where a fireproof roofing material is necessary, however, the makers of these papers inform us that they propose to soon put on the market a paper which will be both fireproof and waterproof. Whether they will be able to make their paper non-inflammable without seriously impairing its strength and waterproof qualities remains to be seen. But for many uses to which we think it worth while to call the especial attention of contractors and engineers, the question of inflammability has little weight. There are a great many engineers and contractors who are obliged to live for months in hastily constructed shanties at the coldest season of the year; an expenditure of a few dollars on one of these papers, to cover the whole roof and sides of the building, would keep out wind and storm and make a great difference in the comfort of the occupants. The experience of one of the editors of this journal is in point in this case. Having occasion to spend a winter in a flimsily built structure on a point exposed to gales from the Atlantic, he covered the inside of his room—roof, walls, and ceiling—with ordinary carpet-lining paper, and testifies that it made as warm quarters as he ever enjoyed.

Of the many other uses of these papers, for sheathing and building purposes beneath slating, tin, or clapboards, or in the place of back-plaster, and in car construction, especially for refrigerator cars, it is not our purpose at this time to speak. It is manifest that a paper so thoroughly water and airproof is well suited for these and many other similar uses, and is worth much more than its cost. At the same time, for places where direct exposure to the weather is not required there are other papers on the market which are perhaps waterproof enough for use in such places, and which come into competition with these papers. Many of the sheathing papers on the market, however, among which are the cheaper grades of the "rosin sized" and some of the "felt" paper, are little better than a layer of blotting papers for protection from wind and dampness. It should be borne in mind that the principal virtue of paper when used for sheathing is not in its action as a non-conductor, but as a means of excluding air and also leakage from driving storms. To use a porous spongy paper for sheathing, therefore, gives comparatively little benefit. There are some brands of paper in the market, however, which are similar to the "Neponset" papers in being of close, firm texture, and are perhaps quite waterproof enough for use where not directly exposed to the weather. For roofing purposes, however, or for any place where direct exposure to the weather is essential, we have as yet found no paper so absolutely waterproof as the Neponset.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York, Lake Erie & Western.—This company has located a short branch from Carbondale to Honesdale, Pa. There will be a tunnel 2 miles in length on the line.

New York, New Haven & Hartford.—At a special meeting of the stockholders held Sept. 16, it was voted to increase the capital stock of the company from $15,550,000 to $18,600,000. This is a part of the increase of the stock to $50,000,000 authorized at the last session of the Connecticut Legislature for the purpose of canceling the funded and floating debt of the company, the making of additions and improvements to its property, and in exchange for the stock or obligations of any railway company whose property this company now controls by lease for a term of 50 years or over.

Toledo, Columbus & Cincinnati.—This company has filed a mortgage for $2,500,000 five per cent. fifty years' bonds, with the Central Trust Co., of New York. The money will be used in completing the line from Findlay to Columbus, O.

Pittsburg & Lake Erie. — The double tracking between Beaver and College Station, O., 6 miles, has been completed and work is now in progress on the line between College Station and Homewood, 4 miles. As soon as this is completed the road will be double tracked from Coraopolis to Phillipsburg, 14 miles.

Canadian Pacific.—The report is again in circulation that this company will soon build a bridge across the Niagara river and make connections with some American line of railway.

Columbus, Lima & Milwaukee.—Twenty miles of this road between Lima and Defiance, O., has been graded and the remaining portion will be graded within 30 days. As soon as the grading is completed tracklaying will begin, and it is expected to have this portion of the road in operation by Nov. 1. The intention is to build from Defiance, O., to Bryan, Mich., and to use the tracks of the Cincinnati, Jackson & Mackinaw R. R. from Bryan to Allegan, Mich., building an independent line from Allegan to Saugatuck, Mich. It is expected to have the road in operation from Lima to Saugatuck by Jan. 1, 1890. There will be a 2-span steel bridge across the Scioto river. J. E. Richards & Co. have the contract for building the division from Lima to Defiance, 43 miles. B. C. FAUROT, of Lima, is President.

Chesapeake & Ohio.—This road has already issued $1,500,000 out of the $4,600,000 consolidated 5 per cent. bonds reserved for improvement purposes. The company has bought 1,000 freight cars, 16 vestibule cars, and 30 locomotives. New shops have been built at Clifton Forge, the shops at Richmond have been enlarged, and more yard room secured at Clifton Forge and other points on the line. Ten miles of double track, two branch lines from the coal regions, and about 25 miles of side-track have been put in at various points.

Maine Central.—The extension from Fabyan's to Scott's, N. H., 17.55 miles, has been completed. The line is laid with 72-lb. steel rail.

Ohio Southern.—At a meeting of the stockholders recently held, action was taken providing for an issue of bonds, and for the payment of all car-trust obligations. Authority was also given for making certain extensions.

New York, Ontario & Western.—About two-thirds of the grading on the Scranton & Forest city branch has been completed. The entire line is to be graded ready for the rails by Jan. 1, 1890, and it is expected that tracklaying will be finished by May 1, 1890.

Louisville, Cincinnati & Dayton.—A press dispatch states that the completion of the necessary papers is now in progress and that the practical work of construction will soon begin on the extension from Aurora Madison, Ind.

Buffalo, Rochester & Pittsburg.—The work on the branch of the Lincoln Park & Charlotte R. R. to the docks is progressing favorably. The grading will be completed in a few days, and as soon as the bridge across the Charlotte branch of the New York Central & Hudson River R. R. is completed, tracklaying will begin and will be pushed rapidly to completion.

St. Johnsbury & Lake Champlain.—A large force of men is now at work filling the long Pumpkin Hill trestle. The trestle is 75 ft. high, and it is estimated that the work will cost $60,000.

Canadian Pacific.—It is stated that this company proposes to construct a line from Cooksville to Hamilton, Ont., immediately, and possibly from Toronto to Hamilton.

New York Central & Hudson River.—It is announced that surveys are being made for an extension from Katonah, N. Y. to Danbury, Conn., a distance of 16 miles.

Philadelphia & Reading.—Construction is reported in progress on the branch from Kalmia to the Clark's Valley coal fields. The length of the branch will be about 6 miles.

Vaudreuil & Prescott.—We have received the following information from J. M. SHANLY, of Hudson, P. Q., engineer in charge of construction.

The road is projected to run from Vaudreuil, P. Q., via Hudson, Rigand, Caledonia Springs, and Plantagenet to Ottawa, a distance of 86 miles. The maximum grade on the route surveyed is 0.75 per cent. and the maximum curve is 5°. There will be a bridge at Nation river about 600 ft. long. The principal business of the road will be in lumber from the Ottawa district and farm produce. A great portion of the right-of-way has been secured and about $1,000 per mile local aid in addition to the usual Government aid. About 20 miles of the line have been located and the remainder will be put under survey some time this fall. The contract for building the road has been let to Charlebois & Foster, of Montreal, P. Q., who have sublet the first section to Doran & Hebert, of Valleyfield, Ont. About 3 miles of the grading has been completed and work is now being pushed. It is expected that tracklaying will begin about Oct. 15 and the first section be opened for traffic by Jan. 1, 1890. The company was incorporated in May, 1888, in the interest of either the Grand Trunk or Canadian Pacific railway companies.

New York, New Haven & Hartford.—About 400 men are now at work on the road bed for the double track between South Lyme and East Lyme, Conn. It is expected that the grading will be completed this season, but track will not be laid until next spring. The distance between the two places is only 4 miles, but a considerable amount of work will be necessary as a portion of the road will be entirely new and stone culverts will be built in place of trestles.

Wilmington & Northern.— It is stated that surveys have been completed for a branch from Joanna Station to Joanna furnace, Pa., a distance of 2 miles.

Projects and Surveys.

Northern Maine.—A director of the Maine Central R. R. is quoted as saying that his company had made a proposition to this company to lease the road as soon as built, paying 4 per cent. interest on a valuation of $30,000 per mile, the lease to run for 99 years. The road is projected to run from Mattawamkeag to Presque Isle, Me., 114 miles. GEO. B. WESCOTT, of Portland, is President.

Brigantine.—Incorporated in New Jersey to build a line of railway from a point on the Camden & Atlantic R. R. near Absecom to Centerville, a distance of about 4 miles. Surveys will commence at once.

Oneida, Oneonta & New York.—J. W. WARNER, of Oneida, N. Y., President, has furnished us the following data concerning this enterprise.

The road is projected to run from Oneida, N. Y., via Vernon Center, Brookfield, New Berlin and Morris to Oneonta, a distance of 70 miles. The surveys, which are now well under way, will be completed by Oct. 1. The work will be light and grades and curves easy. The route is through one of the finest hop-growing and farming sections of the State. The work of securing the right of way has just commenced. A large amount of local aid has been secured by private subscription. The company was incorporated Aug. 20, 1889. WALTER F. RANDALL is Chief Engineer.

Trenton & Point Pleasant.—A project is on foot to build a line of railway from Trenton to Point Pleasant, N. J., a distance of about 40 miles. A large part of the capital stock has been subscribed and most of the right of way secured. Surveys will be commenced soon. C. C. VERMEULE, of 71 Broadway, New York, is Chief Engineer.

SOUTHERN.—Existing Roads.

Kanawha.—Work is being rapidly pushed on the extension of this road to the Cabin creek coal fields. About 2 miles of the line have been graded, and it is expected that the entire 9 miles will be completed by Jan. 1, 1890.

Farmville & Powhatan.— H. A. WHITING, of Powhatan C. H. Va., Chief Engineer, sends us the following data:

Van Doran & Strother, of Powhatan C. H., have the contract for building the extension from Summit Station on the Bright Hope R. R., to Powhatan. About 63 miles of the road have been graded and 26 miles of track laid since June 10. About 80 men are now at work tracklaying. The work of construction is in charge of the Chief Engineer.

Charleston, Cincinnati & Chicago.— The contractors, McDonald, Shea & Co., of Memphis, Tenn., have sublet contracts for grading and masonry to P. F. Coogan, S. D. Dunnavant, Goodman & Foster, W. McD. Burgin, N. S. Scott, J. C. Sullivan and F. C. Inglesing & Co. The contract for building the cattle-guards and trestles has been let to L. C. Gold.

South Florida.—The contract for building the depot at Orlando, Fla., has been let to W. T. Cottler for $18,871.

Louisville Southern.— J. H. PEARSON, of Nicholasville, Ky., Chief Engineer, sends us the following information concerning this enterprise:

The road is projected to run from Versailles, Ky., via Nicholasville, Richmond and Irvine to Beattyville, Ky., a distance of 95.18 miles. The work is very light considering the mountainous character of the country through which the road runs. The maximum grade is 80 ft. per mile, and this is only for a short distance in getting down to a low crossing of the Kentucky river. With this exception the heaviest grade is 66 ft. per mile. The maximum curve is 8°. The line from Versailles to Irvine passes through the midst of the blue grass region, and from Irvine to Beattyville the route is through a heavily timbered country rich in coal and other minerals. There will be 3 tunnels on the line, 675 ft., 350 ft., and 250 ft. respectively. There will be two bridges across the Kentucky river; at Tates creek, 1,560 ft. long, channel span 300 ft., three flanking spans 150 ft. each, and a viaduct approach at each end, with a total length of 810 ft.; and at Irvine, Ky., 1,250 ft. long, channel span 250 ft. and five flanking spans 200 ft. each. There will be two large viaducts, one across Marble creek 770 ft. long and 211 ft. high, and the other across Neal's branch 570 ft. long and 180 ft. high. In addition there will be considerable trestle work. The principal business of the road will be in agricultural products, coal, iron and lumber. All of the right of way has been secured with the exception of the division between Versailles and Nicholasville, 15.16 miles, and local aid to the amount of $555,000 has been received from the counties along the route. D. Shanahan & Co., of Louisville, Ky., have the contract for building the road with the exception of the division from Versailles to Nicholasville. About 1,000 men are now at work on the line, and 22 miles of the grading have been completed and 3,000 ft. of track laid. The work of construction is in charge of J. H. PEARSON, Chief Engineer, and S. F. ROCK, engineer for the contractors.

Georgia & Tennessee.—This company has applied to the Georgia Legislature for a charter empowering it to construct a railway from Dawson, Ga., to the Florida coast south of Thomasville, to extend the Chattanooga, Rome & Columbus R. R., from Carrollton to Warm Springs, and to consolidate with the Chattanooga, Rome & Columbus, and the Columbus Southern railways. This is supposed to be the first step in the scheme for a through line from Chattanooga to the Gulf coast, noted in our issue of July 6.

Louisville & Nashville.—This company is reported to

have under consideration the building of an extension of the Owensboro & Nashville R.R. from Adairville to Springfield, Ky.

Louisville & Nashville.—R. E. O'Brien, engineer in charge of the Cumberland Valley extension, has let the contract for the remaining 47 miles of this line. The entire distance is now under contract. The contractors are: Winston Bros. & Co., of St. Paul, Upper & O'Connor, of Cleveland, O., Henry Davin, of Lexington, Va., and Mason, Hoge & Co., of Frankfort, Ky.

Ohio & Big Sandy.—The Chattaroi R. R. Co., has completed its reorganization by the election of the following officers: B. W. Foster, of Huntington, Ky., President, Stuart Meckie, of New York, Vice-President, and E. St. John, of New York, Secretary and Treasurer. It is stated that the road will be extended from Richardson, Ky., through Tazewell county, Va., to Pocahontas, Va. Surveys have all been made and the preliminary contracts are reported let to Louisville, Ky., contractors.

Albemarle & Pantego.—We have received the following from Geo. W. Roper, of Roper, N. C., Superintendent:

This road, which is connected by a transfer of 9 miles across Albemarle sound with the Norfolk Southern R. R., at Edenton, N. C., is now completed for a distance of 16 miles south from Mackey's Ferry. The northern terminus of the road is at the headwaters of the Pungo river, from which point work is now being pushed rapidly forward to a point 14 miles distant called Matchet Pungo, situated on a bay emptying into the Pamlico sound. The construction is under the direction of the superintendent. It is expected that the road will be opened for traffic by Jan. 1, 1890, and that it will do a large business in lumber and garden truck.

Atlantic & Danville.—The City Council of Danville, Va., has ordered an election on the question of voting $150,000 in aid of the Danville & East Tennessee R. R. The order provides that the election shall be held Oct. 15, and the surveys begin within 30 days and construction within 90 days from that date. The subscription is to be paid as follows: $50,000 when the company, by July 1, 1891, shall have constructed or acquired a standard gauge railway from its depot in Danville, Va., to Madison, N. C., or some other point westwardly from such depot and as far therefrom as Madison, or shall have acquired the ownership of the Danville & New River R. R., and shall have converted the same into a standard-gauge road from Danville to Stuart, Patrick county, Va.; $50,000 upon the construction of 50 additional miles of new road as a part of such continuous through line on or before July 1, 1893; the remaining $50,000 upon the completion of the line to the main line of the Norfolk & Western railroad at Max Meadows or Bristol, on or before Jan. 1, 1895.

Genesis & Obed River.—Contracts will be let about Jan. 1, for building the division of this road between Pilot Mountain and Lavender, 10 miles. J. M. Holmes, of Genesis, Tenn., is Chief Engineer.

Alabama Midland.—This road has been opened for traffic from Bainbridge, Ga., to Ozark, Ala. Construction is being pushed from Ozark to Troy and it is expected that the road will be completed between these points within four months.

Louisville, New Orleans & Texas.—Surveys are reported in progress for a branch from Lula, Miss., down the Coldwater and Tallahatchie bend, via Greenwood and Yazoo City to Vicksburg. The division from Lula to Greenwood will be built this season and the remaining portion will be built next year.

Richmond & Danville.—The Western North Carolina R. R. is completed to a point within 2 miles of Valleytown, N. C.

Cape Fear & Yadkin Valley.—Tracklaying has been completed to a point near Moor's creek, a distance of 16¼ miles. The bridge over the Black river is completed and work is being pushed on the entire line.

Projects and Surveys.

Albany & Cordele.—Capt. L. W. Roberts, Chief Engineer, has commenced the preliminary survey for this proposed Georgia road. It is expected that the survey will be completed in about 10 days and active steps taken toward the construction of the road.

Midland Transit.—This company has been incorporated to build a railway from Rochelle to Melrose, Fla. Among the incorporators are: W. J. Winegar and R. W. Davis, of Alachua, Fla.

Georgia.—The following bills have passed the Georgia State Senate: to amend an act incorporating the Waycross Air Line R. R. Co., to incorporate the Belton, Homer & Carnesville R. R. Co., and to incorporate the Washington & Lincolntown R. R. Co.

NORTHWEST.—Existing Roads.

Oconto & Southwestern.—O. A. Ellis, of Oconto Wis., President, writes us that this company, whose incorporation to build a railway from Oconto southwest was noted in our issue of Aug. 17, has completed the surveys for the proposed line, which will be 14¼ miles long. The contract for building the road has been let to McIntosh Bros., of Milwaukee, Wis. The work will be generally easy as the country through which the road runs is nearly level. The right of way has been all obtained, and sufficient capital secured to build the road. It is expected that the line will be opened for traffic about Nov. 1. The company was incorporated in June, 1889. Fred Kirchman is Chief Engineer and Geo. Beyer is Secretary.

Winona & Southwestern.—This company has asked the city of Winona, Minn., to subscribe $100,000 in aid of the road. A press dispatch from Winona states that a number of contractors are in the city figuring on the proposed 10-mile extension from Bear Creek station to Utica, Minn.

Northern Pacific.—President Oakes of this company denies the report that his company has in contemplation the building of any extensions in the Canadian Northwest outside of Manitoba.

The official announcement of the details of the new financial scheme proposed by Director Henry Villard has been made. The terms of the proposal are that $81,202,000 of the new consolidated mortgage bonds shall be held to retire the first, second and third mortgage bonds, $26,000,000 to be used for the retirement of existing branch line bonds; $18,000,000 for the construction, purchase or lease of tributary roads at a rate not exceeding $30,000 per mile, and the balance, $34,798,000, is to be used for betterments and renewals not properly chargeable in operating expenses; for the surplus earnings due to the preferred stock, under the plan of reorganization, and for premiums on prior mortgage bonds and other purposes.

Union Pacific.—Press dispatches state that this company has several surveying parties in the field locating a line from the western terminus of the Utah Central R. R., at Milford to San Diego, Cal.——The contract for the construction of the repair shops at Anaconda, Mont., has been awarded to N. C. Chapman, of Milwaukee, Wis.

Milwaukee & Northern.—The grading on the extension of the Ontonagon & Brule River R. R., from Adventure creek to a connection with the Duluth, South Shore & Atlantic R. R., a distance of 26 miles, is completed and tracklaying is now in progress.

Chicago & Northwestern.—It is stated that the contract has been let to Robinson, Sang & Co. for grading and bridging the line from Beechwood to Iron River, Minn. It is also announced that a branch will be built from Kasson to Mantorville, Minn. The line is to be in operation by Nov. 1.

Canadian Pacific.—The award of the contract for building the extension of the Qu' Appelle, Long Lake & Saskatchewan R. R. from Long Lake to the Saskatchewan river, about 150 miles has given rise to the rumor that the line will be continued west via Edmonton, Assiniboia, to Vancouver, B. C.

Chicago, St. Paul & Kansas City.—The annual report of this company for the year ending June 30, 1889, shows the following results from operations as compared with the previous year:

	1889	1888.
Gross earnings	$2,774,888	$2,251,515.
Operating expenses....	2,039,237	1,775,881
Net earnings	$735,651	$475,634

Canadian Pacific.—About 1,000 men are now at work on the extension of the Qu' Appelle, Long Lake & Saskatchewan R., R. and about 40 miles of the grading is reported completed. Tracklaying is now in progress. Rails for laying 20 miles of the track are on hand. It is expected that about 100 miles of the grading will be completed this season.

SOUTHWEST.—Existing Roads.

New Orleans, Natchez & Ft. Scott.—W. Dunbar Jenkins, Chief Engineer, writes us that the contract has been let for building 75 miles of this road from Natchez, Miss., to Rayville, La. There will be inclines and transfer boats across the Mississippi river at Natchez, and a draw-bridge over the Tensas river. Surveys will soon be made for extensions south from Natchez to New Orleans, and north from Rayville to Fort Scott. Tracklaying will commence as soon as the grading and bridging is completed.

Louisville, New Orleans & Texas.—A press dispatch states that construction is now being pushed on the Mississippi Valley R. R., which is projected to run from Baton Rouge, La., to Arkansas City, Ark., a distance of 261 miles, and it is expected that the line will be in operation in one year.

Texarkana Northern.—We are indebted to J. E. Dougherty, of Texarkana, Tex., Chief Engineer, for the following information:

The road is projected to run from Texarkana, to Fort Smith, Ark., a distance of 180 miles. Fifteen miles of the line from the Red River north is now under construction. Preliminary surveys have been made for the entire line and about 50 miles of the locating surveys completed. The 15 miles now under construction is all in Little River county. The route of this portion is through a level timber country affording light work and easy grades and surveys. There is an 850-ft. bridge across the Red River on which work is now in progress. A. J. Tullock, of Leavenworth, Kan., is the contractor. The contractors for the grading are the Grigsby Bros., and Ben. Whittaker, of Texarkana, Tex. About 50 teams are now at work on the line and over one-third of the grading has been completed. It is expected that tracklaying will begin about Dec. 1, and the portion now under construction be opened for traffic by Jan. 1, 1890.

Chicago, Kansas City & Texas.—A dispatch from Liberty, Mo., states that the surveys for the extension from Smithville to Edgerton, Mo., are completed and that the engineers are now at work surveying a line from Smithville to Grayson, Mo. The route selected depends upon which place offers the best inducements. The road will ultimately be continued to St. Joseph.

San Antonio & Aransas Pass.—Construction is being pushed on all of the extensions of this Texas road. The work of grading from Luling to Lockhart is about completed, and it is expected trains will be running between these two points by November 1. The branch to Waco via Giddings, Rockdale, and Cameron, will probably be completed, and regular trains running on it by the first of the new year. The company also has under consideration an extension north of Lockhart to Georgetown by way of Webberville and Taylor. The Llano extension, it is expected, will be completed to Llano within six months. It is announced that surveys will soon commence for the extension from Houston, Tex., to Alexandria, La.; and that as soon as the line is located, construction will commence.

Projects and Surveys.

Memphis, Arkansas & Texas.—This company, which was incorporated some time ago to build a railway from a point on the Mississippi river opposite Memphis, Tenn., through the State of Arkansas to a point in Texas near the eastern boundary of the State, has completed its organization with the election of the following officers: President, George Arnold; Vice-President, Holmes Cummins; Secretary and Attorney, George Gilham; Treasurer, C. W. Schulte; Chief Engineer, T. G. Dabney, all of Memphis. Directors, George Arnold, T. F. Duffin, S. H. Brooks, and Holmes Cummins, of Memphis, N. B. Price, Mt. Adams, Ark.; Parker C. Ewing, Clarendon, Ark.; Henry P. Rogers, and P. E. Matthews, Marianna, Ark. The surveys for the road were made some time ago. It is stated that construction will commence at once.

Brazos Dock & Channel Co.—G. W. Angle, General Manager of this company, is quoted as saying that inside of 30 days surveying parties would be put into the field to locate a line of railway from Brazos to Llano, and from Brazos to Waco, up the right bank of the Brazos river.

ROCKY MT. AND PACIFIC.—Existing Roads.

Oregon & Washington Territory.—The following information has been furnished us by F. Riffle, of Walla Walla, Wash., Chief Engineer:

About 11 miles of track have been laid on the line from Walla Walla, via Dixie and Waitsburg, to Dayton, 34 miles, and the grading is nearly completed on 16 miles more. The route is through a hilly country, and the work between Walla Walla and Waitsburg is heavy. There is also considerable side-hill rock work near Dixie. The maximum grade on each side of the summit between Walla Walla and Waitsburg is 1.7 per cent. There are only three curves exceeding 3°, and only six exceeding 4°. The right of way has all been obtained and $30,000 local aid secured. G. W. Hunt, of Walla Walla, is the contractor. It is expected to have the road in operation by Dec. 1, 1889.——The line from Fulton to Butter creek, a distance of 30 miles, has been located. The date of beginning work is indefinite.——The Eureka Flat branch, which was completed last year from Eureka Junction to the head of Eureka Flat, has been located to the Snake river, 13 miles beyond the present terminus. The date for commencing construction has not been decided upon.——Surveys are now in progress on the line from Walla Walla to Union, a distance of 120 miles.——In addition to the 11 miles of track laid on the Walla Walla-Waitsburg extension, 7 miles of track have been laid from Fulton to Pendleton, Ore.

Wyoming, Salt Lake & California.—About 12 miles of this road have been graded from Salt Lake City west, and 25 miles between Salt Lake and the Wyoming border. Work will soon commence from the Wyoming border to Evanston, Utah.

San Francisco & North Pacific.—Tracklaying is now in progress on the branch from Santa Rosa to Sebastapol, Cal., and it is expected to have the line completed within 30 days. Efforts are being made by the people along the route to have the road extended to Rey's Summit, several miles northwest of the present terminus.

Denver & Rio Grande.—It is reported that surveys are in progress for a line from Kelton, Utah, down the south fork of the Boise river to Boise City, Idaho.

Silver City, Pinos Altos & Mogallon.—We have received the following data from John A. Miller, of Silver City, N. M.:

The road is projected to run from Silver City, via Pinos Altos, Central City, Hanover, Santa Rita, Gila and Pleasanton to Alma, a distance of 140 miles. Nine miles of the line have been surveyed, and construction is now in progress. The principal business of the road will be in lumber and minerals. There will be one bridge across the Gila river. All of the right-of-way has been secured. It is expected that tracklaying will commence in about 30 days, and the first 10 miles be opened for traffic by Nov. 1. Wm. H. Newcomb, is President, and R. L. Powell, is Chief Engineer.

Projects and Surveys.

Montana & Canada.—It is stated that negotiations have been closed for the construction of this Montana road, and that work will begin this fall. The road is to run from a point on the International boundary south about 10 miles west of the Sweet Grass Hills, and thence via Fort Benton to Helena. The route is through an almost entirely undeveloped portion of the country. The principal movers in the enterprise are R. W. Cameron, S. T. Hauser, W. A. Ramsey, W. G. Conrad, and O. R. Allen.

Levee Work.—The following proposals for levee work were opened Sept. 10 by the Board of Mississippi Levee Commissioners, Greenville, Miss. Contracts were awarded as follows: Clover Hills levee, to J. A. Newcomb, of Kansas City, Mo. 68,000 cu. yds. embankment at 12 cts., $8,440; Eldorado to Tennessee, to E. Hyner, of Greenville, Miss. 43,000 cu. yds. at 13 cts., $6,240; Tennessee to Purnell's, to L. C. Dulaney, of Glenallen, Miss., 67,000 cu. yds. at 12¾ cts., $8,997.50. Total approximate cost, $23,677.50. Embankment is the principal item, the other items being comparatively small. Mr. WM. STARLING is Chief Engineer, and Mr. ROBERT SOMERVILLE, Assistant Engineer.

Bidders.	Clover Hill Levee.							Eldorado to Tennessee.							Tennessee to Purnell's.							Totals.
	Excavation, per cu. yd.	Embankment, per cu. yd.	Muck Ditch, per cu. yd.	Surface Clearing, per acre	Light Clearing, per acre	Heavy Clearing, per acre	Sodding, per sq. yd.	Excavation, per cu. yd.	Embankment, per cu. yd.	Muck Ditch, per cu. yd.	Surface Clearing, per acre	Light Clearing, per acre	Heavy Clearing, per acre	Sodding, per sq. yd.	Excavation.	Embankment, per cu. yd.	Muck Ditch, per cu. yd.	Surface Clearing, per acre	Light Clearing, per acre	Heavy Clearing, per acre	Sodding, per sq. yd.	
	cts.	cts.	cts.	$	$	$	cts.	cts.	cts.	cts.	$	$	$	cts.	cts.	cts.	cts.	$	$	$	cts	
T. M. Sullivan, Memphis, Tenn	15½	15½	15½	5	35	40	¾	15½	15½	15½	6	35	50	¾	14.⅜	14.⅜	14.⅜	6	35	50	¾	$28,366.50
Berry, Dean & McKinney, St. Louis, Mo.		13¼	12	6	12	30	1		19	12	6				1	17¾	12	6				1	30,456.50
J. L. Perkins, Greenville, Miss																13	13	4½	9	19	1	9,255.00
P. F. Lamb, Memphis, Tenn		16	16	10	25	40	1		15	15	10	30	40	1		14	14	8	24	35	1	28,285.00
Jeffries & Dameron, Crews, Miss	15	14¾	18	10	25	40	¾	15	16½	18	10	25	40	¾	15	16	18	10	25	40	¾	29,107.50
C. A. Winter, Avon, Miss		14¼	14¼	15	25	45	1		14⅞	14⅞	15	25	45	1		13⅛	13⅛	15	25	45	1	26,607.50
J. A. Newcomb, Kansas City, Mo.	13	12	13	5	15	35	¾	16	16	18	8	20	40	¾	15	14	14	5	15	35	¾	25,580.00
R. Johnson, Memphis, Tenn.	14	14	14	10	20	40	1	15	15	15	12	25	60	1	14½	14⅝	14½	10	20	40	1	27,300.00
W. L. Killebrew, " "		13¾	13¾	15	30	60	1		15.⅝	15	15	30	60	1		15	15	15	30	60	1	27,709.50
W. R. Harvey & Co., "	14¾	14¾	14¾	5	10	30	1	15	15	15	7	10	30	1	14⅜	14½	14½	7	10	30	1	27,697.50
A. Arnold & Co., "	13½	13⅜	15	15	15	25	¾	15	15	15	15	15	30	¾	15	15	15	15	15	30	¾	27,075.00
J. A. Cameron, Greenville, Miss									14	14	20	20	40	1		14½	14	20	20	40	1	16,850.00
E. Hyner, " "								13	13	13	15	20	25	1	14	14	14	15	20	25	1	16,270.00
L. C. Dulaney, Glenallen, Miss.	14	12¾	14	15	15	50	¾	14	14½	14	7	15	40	¾	14	12¾	14	8	15	35	¾	24,692.50

Five Standard Specifications.

		Pages.
No. 1.	Brick and stone passenger stations	19
2.	Brick freight houses	18
3.	Locomotive engine houses	19
4.	Frame passenger stations	21
5.	Frame freight houses	19

The specifications were drawn by C. F. BOND, C. E., of the N. Y. C. & H. R. R. R., for the use of that company. Being in type it was a very commendable service on the part of Mr. BOND to have an edition of each printed for general use. They are complete in every detail, and must inevitably be the specifications for general use for railroad buildings hereafter. They are printed on excellent paper, and the price is 50 cents per specification, or $2.50 per set.

Lookout Mountain.—It is stated that this road will build a line of its own from a point 500 yds. above the present junction to Forest Hills cemetery, thence in a straight line to Cravens, where the Nashville, Chattanooga & St. Louis tracks will be reached and used for running into Chattanooga, Tenn.

RAPID TRANSIT.

Street Railways.—***Newark, N. J.***—The Rapid Transit Co. has received its franchise, and has been granted permission to experiment with the storage battery system.

Somerset, Ky.—A street railway company has been organized. President, SAMUEL WHINNERY, Secretary; C. B. FORMAN. Capital stock, $10,000.

Hopkinsville, Ky.—A street railway franchise has been granted to S. H. TURNER.

Ocala, Fla.—A street railway franchise has been applied for by H. M. TAYLOR. The Ocala & Suburban Ry. Co. has applied for an extension of its franchise.

Chicago, Ill.—The Chicago Central Street Ry. Co. has been incorporated by BELTON HALLEY, J. H. LUDDEN, and PAYTON MCKILLIP. Capital stock, $500,000.

Duluth, Minn.—The Duluth Street Ry. Co. will build an incline road at Superior St.

Des Moines, Ia.—The street railways have been consolidated. J. S. POLK is president of the combination.

Portland, Ore.—The Willamette Heights Ry. Co. has been incorporated by GEO. W. BATES, J. C. MORELAND, and JOHN HALE. Capital stock, $100,000.

Electric Railways.—***Attleboro, Mass.***—The Attleboro Electric Street Ry. Co. has ordered 10,000 T-rail chairs from R. T. WHITE, of Boston, The Thomson-Houston system is to be used.

Reading, Pa.—Surveys have been completed for an electric road 8 miles long to the Neversink mountain.

Duluth, Minn.—The Duluth Street Ry. Co. will adopt an electric system for its West Duluth extension.

Austin, Tex.—The Austin City Ry. Co. will adopt an electric system.

HIGHWAYS.

New Jersey Roads.—City Attorney BERGEN, of Elizabeth, in a late interview on the Union county new roads says:

As to the complaint of people of Summit, because contracts were not awarded at the recent meeting of the Freeholders to complete the road to New Providence, it was from no disposition to discriminate against any part of the county, but due entirely to the fact that by the estimates for the work it was found that it would cost about $240,000 to macadamise the three principal roads which the Freeholders have adopted—that is, from Elizabeth to Rahway, from Elizabeth to Plainfield, and from Elizabeth to New Providence via Summit. Under the law as it now stands, the Freeholders can only issue bonds to the amount of $150,000, which, of course, prevented the construction of all the roads at present.

Mr. BERGEN further says that at the meetings of the citizens of Union county held last winter to consider the project, it was estimated that it would cost from $250,000 to $300,000 to pave the three roads with Telford, that is, about $10,000 a mile. As the bill was originally drawn and introduced, it gave the Freeholders power to issue bonds for road purposes to the extent of 3 per cent. of the assessed value of the real estate in the county. This would have permitted bonds to be issued to the amount of $700,000. The bill met with considerable opposition in the Legislature, especially for the reason that it permitted the expenditure of so much money, and it was necessary to amend it in this particular in order to insure its passage. It was understood at the time the bill was passed that not enough money could be raised under it to improve the roads in this county as they ought to be, but it was thought best to make a good beginning with the money provided, and obtain authority from the next Legislature to issue whatever additional bonds may be needed.

Mr. BERGEN thinks the Freeholders have fairly distributed the money at their command this year. More is to be expended on the road towards Summit than on the road to Plainfield. Both must remain unfinished until more money can be raised. The whole work of improving the three roads will be less than the original estimate. He does not think there is any doubt at all about the completion of the roads according to the plans laid out by the Freeholders within a year.—*Newark (N. J.) Advertiser.*

Road Legislation for the American State. By W. JENKS, Ph. D. We have added this valuable contribution to the literature of highway construction, administration, and maintenance to our stock of books for sale, and will hereafter be able to fill all orders for it. Since our recent notice of it there has been an active demand for copies, which we have referred to the Secretary of the American Economic Association at Baltimore, or to the several selling agents throughout the country. The price is 75 cts., and it is well worth many times that to interested parties. A table of contents is published in our advertising columns.

CONTRACTING.

Gate House.—The only bid received Sept. 10 by CHAS. MORTON, Superintendent of Sewers, Boston, Mass., for constructing a brick gate-house with foot bridge and balcony complete, at the inlet chamber, Stony brook, rear of Pynchon St., Roxbury district, was from W. H. Keyes & Co., of South Boston, at $4,642. The bid was rejected.

Catch Basins.— At Green Island, N. Y., the Sewer Commissioners have awarded the contract for the 4 additional catch-basins to John McGowan at $70 each, and the 6 extra cap-stones for flush-tanks will be furnished by the same contractor for $35 each.

Lumber. — The Department of Public Works, New Orleans, La., has awarded a contract for furnishing lumber to M. Adams at $12 per 1,000 ft. B. M.

Asphalt Paving.—***Buffalo, N. Y.***—The following proposals have been received by the Park Commissioners for paving the Circle and the Bank: Northwest Stone & Marble Co., Detroit, $11,233.35 and $6,060; German Rock Asphalt & Cement Co., $8,775 and $7,495; Barber Asphalt Co., New York, $10,425 and $8,675 (or $7,380 for the latter with bituminous base).

The bid of the Barber Asphalt Co. for the Circle was accepted, and that of the German Rock Co. for the Bank. At the Circle the asphalt is to be laid on a macadam road bed already made, but on the Bank the contractor is to furnish a concrete base. The surfacing of the macadam with asphalt will cost about $1.75 per sq. yd., and the asphalt with concrete base about $3 per sq. yd.

Louisville, Ky.—The following proposals were received recently: Western Paving & Supply Co., Chicago, $38.38 per square of 100 ft.; Barber Asphalt Paving Co., $38.88. The contract was awarded to the Barber Co. which gives a guarantee for 10 years.

Cement.—The following proposals have been received by the Department of Docks, New York City: For 500 bbls. of slow-setting and 500 bbls. of quick-setting cement; James Brand, $2.30 per bbl. for slow-setting, $2.35 per bbl. for quick-setting; S. L. Merchant & Co. $2.45, $2.45; Marcial & Co., $2.50, $2.50; Dickinson Bros. & King, $2.52, $2.35; Sinclair & Babson, $2.57, $2.57; Eckmeyer & Co., $2.35 for slow-setting; Haebler & Co., $2.30½ for slow setting; E. W. Fisher, no bid. The contract was awarded to James Brand.——For 500 bbls. of quick or slow setting cement: Donaldson Bros. & Co., $2.10 per bbl.; Haebler & Co., $2.25; James Brand, $2.25; Marcial & Co., $2.40; E. W. Fisher & Co., $2.45; Sinclair & Babson, $2.50. The contract was awarded to Donaldson Bros. & Co.——For 500 bbls. of quick or slow-setting cement; James Brand, $2.28; Haebler & Co., $2.28½; Dickinson Bros. & Co., $2.35; Marcial & Co., $2.40; Sinclair & Babson, $2.50. The contract was awarded to James Brand.

Roofs.—The Providence Gas Co., of Providence, R. I., has awarded the contract for the iron roof over its new buildings to the Berlin Iron Bridge Co., of East Berlin, Conn.——David Sluskey has the contract for tin roofing for the new government building at Augusta, Ga., for $8.25 per sq. yd.

Building.—The Kings County Supervisors, Brooklyn, N. Y., have awarded the contract for the boiler house at St. Johnland to James W. Birkett at $33,890.

Street Work.—***New York, N. Y.***—Public Works Commissioner GILROY has awarded to Matthew Baird the contract for paving Whitehall St. from Beaver St. to the river for $44,143. The Public Works Department's engineers estimated the cost of the work at $51,010.

Louisville, Ky.— Contracts have been awarded to J. R. Gleason at the following prices: excavation, 30 cts. per cu. yd.; new curb, 70 cts. per lin. ft.; old curb reset, 15 cts. per lin. ft.; new binders, $1 per lin. ft.; old binders reset, 20 cts. per lin. ft.; new 18-in. and 24-in. corner stones, $2.50 and $3 each; resetting old corner stones, 40 cts. each; cutting water-way checks, 75 cts.; cutting ends of old curb, 15 cts.; granite paving with concrete foundation without bituminous joints, $9 per square of 100 sq. ft.; granite paving with concrete foundation and with broken stone, $13 per square of 100 sq. ft.

Madisonville, O.—The contract for Central Ave. has been awarded to J. M. Peters, as follows: excavation and embankment, 35 cts. per cu. yd.; macadamizing, $1.40 per cu. yd.; screened and unscreened gravel, $1.35 and $1.50 per cu. yd.; masonry, $4.50 per cu. yd.; curbing, flagging gutters and crossings, 50 cts. per lin. ft.; stone pavement, 90 cts. per sq. yd.; 15-in. drain tile, $1 per ft. The contract for Moore St. was awarded to Edward Sullivan, as follows: excavation, 30 cts. per cu. yd.; embankment, 6 cts. per cu. yd.: macadamizing, $1.50 per cu. yd.; unscreened gravel, 85 cts. per cu. yd.; masonry, $3 per cu. yd.; paved gutters, 90 per sq. yd.: 12 and 24-in. drain pipe, 50 cts. and $1.40 per ft.

Kansas City, Mo.—For paving with cedar blocks the following contracts have been let: 18th St., from Olive to Prospect, J. G. and D. J. McBean, at $1.57 per sq. yd.; paving 4th St., from Walnut to Grand Ave., Andrew Jaicks at $1.55; Oak, from 8th to 12th, J. B. Smith & Co., $1.37; Summit, from 21st to Southwest Boulevard, Barber Asphalt Co., $2.80. The repaving of 6th St. from the alley on West Broadway to Bluff St. was let to J. G. & D. J. McBean at $1.03. The curbing of 18th, from Olive to Prospect, was let to James J. Grady at 60 cts.; Independence Ave., from Walnut to Grand Ave., to Kepley & Arnent at 75 cts. for new, 15 cts. resetting and 10 cts. redressing; Oak, from 8th to 12th, to James J. Grady, 62 cts. new, 15 cts. redressing and 15 cts. resetting.; Baltimore Ave., from 9th to 12th, Thomas J. Ellis, at 86 cts. new.

Los Angeles, Cal.—The following grading contracts

have been awarded: F. W. Barron to grade Kellam Ave., at $2.64 per ft.; Boyles & Crowley, to grade Edgeware road at $2.79 per ft.; P. Bachman, to grade Calumet Ave., at $2.19 per ft.; Chenoworth, to grade Flower St., at $1.48 per ft.; F. W. Barron, to grade Bellevue Ave., at $4.08 per ft.; Los Angeles Construction Co., to grade Aliso St., at $2.50 per ft.

To Contractors.—If you want to have your correct name, permanent address, and business specialty, published in the DIRECTORY OF LEADING RAILROAD CONTRACTORS OF AMERICA, to be distributed in the offices of the General Manager, Superintendent, or Chief Engineer of the principal railways of the continent, please mail us your business card, or your letter heading, without delay. *Understand distinctly that it costs you only a postage stamp.* As we propose to make this Directory *thoroughly reliable*, we will not publish any names except those from which we have a report of some kind. Address at once, ENGINEERING NEWS Publishing Co.

Well.—The contract for the well for the Emmetsburg, Ia., water-works has been let to Deckerman Bros. of that place. Bids for the construction of the balance of the system of water-works are advertised elsewhere in this issue.

Masonry Construction.—For many years past there has been a constant inquiry for a good book on masonry, a practical book for every-day use. There was no work on the subject. Therefore, it was with a great deal of pleasure that we received the first announcement of Prof. BAKER'S proposed work on the subject. That was a couple of years ago, and we now can assure interested parties that there is a good book on masonry construction for sale. The Table of Contents, comprising twelve pages, will be mailed free to any applicant who may wish to know exactly what the book contains before paying its price.

PROPOSALS OPEN.

Electric Lighting.— Plant to be operated by water power. GEO. A. LATIMER, City Engineer, Norfolk, Neb.

Street Work.— Grading and cobblestone paving on Greene Ave. J. P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. Sept. 23.

Siphons.—Two siphons for water pipes at Warren bridge. THE WATER BOARD, Boston, Mass. Sept. 24.

State Canals and Bridges.— Walls on the Erie and Champlain canals; removing obstructions from Oswego river; changing machinery of lift bridges at Clyde and Brockport to water power; rebuilding bridge over the Erie canal; building three iron bridges at Rome, Schenectady and Tonawanda. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. Sept. 24.

Street Work. — Regulating, curbing, granite block paving, crosswalks, etc. Also sewers. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. Sept. 24.

Fencing.—Fencing lots. J. P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. September 25.

Street Work.— Improving Woodland Ave. A. C. MAISH, Village Clerk, Bond Hill, O. September 25.

Tunnel and Culvert.— Driving 400 ft. of tunnel; building 450 ft. of culvert and ditch. THE STREET COMMITTEE, Ashland, Pa. September 25.

Bridge.—Pile bridge. JOHN B. HOWARD, Holly Springs, Miss. September 30.

Jail.—New county jail. Architect, O. G. TRAPHAGEN. E. H. JEFFERSON, care of County Auditor, Duluth, Minn. September 30.

Electric Lighting.—For three years, from Jan. 1, 1890. Not less than 60 lights of 2,000 c. p., suspended across the street or hung on poles. ALVAH L. WITHEREL, City Clerk, Port Huron, Mich. Sept. 30.

Steel Plates.—For the U. S. armored battle ship *Texas*. Hon. B. F. TRACY, Secretary of the Navy, Navy Department, Washington, D. C. Oct. 1.

Machinery.—Machinery and tools for the navy yards at Brooklyn and Portsmouth. Hon. B. F. TRACY, Secretary of the Navy, Navy Department, Washington, D. C. Oct. 1.

Cement.—American hydraulic cement, 700 bbls. T. C. TATE, City Engineer, Keokuk, Ia. Oct. 7.

Steam Heating.—Capt. A. H. YOUNG, U. S. A., Newport, Ky. Oct. 7.

Sewers.—In North Denver sewer district No. 1. F. B. CROCKER, President, Board of Public Works, Denver, Col. Oct. 12.

Artesian Well.—At Fort McPherson, Va. Capt. J. W. JACOBS, U. S. A., Atlanta, Ga. Oct. 14.

MANUFACTURING AND TECHNICAL.

Market Prices.—***Rails.***—New York and the East, $28 to $29 at Eastern mills. Pittsburg, $30 at mill, heavy sections, for delivery in 1889. Chicago, $32 to $32.50 for large orders of standard sections, or $33 for small orders, $35 for 30 and 35-lb. sections.

Track Material.—New York: splice bars, 1.85 cts. to 1.90 cts. delivered; spikes, 1.95 cts. to 2 cts. Pittsburg: spikes, 2.10 cts., 30 days, on cars; splice bars, 1.80 cts. to 1.85 cts.; track bolts, 2.75 cts. to 2.85 cts., with square or hexagon nuts. These prices are expected to be raised. Chicago: steel splice bars, 1.90 cts. to 1.95 cts.; iron splice bars, 1.85 cts.; spikes, 2 cts.; bolts, square nuts, 2.50 cts., to 2.52 cts.; hexagon, 2.65 cts. to 2.70 cts.; prices, f. o. b.

Old Material.—Pittsburg: No. 1 wrought railway shop scrap, $20.50 to $21 net ton; wrought turnings, $13 to $14; car axles, $25 to $26; cast scrap, $14.50 to $15 gross; old car wheels, $18 to $18.50. Chicago: old iron rails, $24.25 to $24.75; old steel rails, $16.25 to $17.50 for short lengths, $18.50 to $19 for long lengths.

The Pond Engineering Co., of St. Louis, Mo., has sold to the Fort Scott Electric Light & Power Co., Fort Scott, Kan., a 125 H. P. Armington and Sims engine. This is the third engine sold to the Fort Scott Co. within a very short time. The company is also furnishing Guthrie, Chase & Co., Milford, Ia., a 50 H. P. Schutte exhaust steam condenser complete with all pipe, valves, etc.

The Energy Mfg. Co., of Philadelphia, Pa., has issued a new illustrated catalogue of hoisting machines for different purposes, elevators, and appliances for machine tools.

The Chicago Bridge & Iron Co., 443 Rookery Building, Chicago, Ill., has been organized, and is successor to the Kansas City Bridge & Iron Co., of Kansas City, Mo., and Horace E. Horton, of Rochester, Minn. The company takes contracts for steel, iron, and combination bridges, masonry and metal substructures, etc.

The Marion Steam Shovel Co.—As the prince of advertisers and showmen said, "Advertising is to a genuine article what manure is to land, it largely increases the product." So it has been proved by the Marion Steam Shovel Co., of Marion, O. They turn out first class machinery, there is no better to be found in any country, and they advertise in ENGINEERING NEWS. They write us on the 12th that they have been compelled, on account of the steady growth of their business, to add to their already large shops, a brick extension 50 ft. by 200 ft. for erecting and painting.

Locomotives.—The Rogers Locomotive Works, of Paterson, N. J., have an order for 3 engines for the Cleveland, Akron & Columbus.

The Schenectady Locomotive Works, of Schenectady, N. Y., are building 25 engines for the Lake Shore & Michigan Southern; the order includes 3 fast heavy passenger engines, 15 mogul freight engines, and 7 switching engines.

H. K. Porter & Co., of Pittsburg, Pa., have sold a heavy logging engine to the Fischer & Burnett Lumber Co. in Mississippi.

Cars.—The United States Rolling Stock Co. is building at its shops at New Decatur, Ala., 250 freight cars for the Louisville & Nashville.

The St. Charles Car Co., of St. Charles, Mo., has an order from the Riordan Refrigerator Car Co., of Chicago, for 100 cars to be run on the East Tennessee, Virginia & Georgia.

The Indianapolis Car Mfg. Co., of Indianapolis, Ind., has an order for 700 freight cars for the Choctaw Coal & Railway Co. The cars will be of 25 tons capacity, and will be fitted with Janney couplers and the Detroit steel brake beams.

The Cleveland, Akron & Columbus Ry. Co. has ordered 500 tubular frame coal cars and 150 box cars.

The Pennsylvania Railroad Co. has given out large orders for freight cars as follows: Altoona shops, 1,000 cars; Peninsular Car Co., Detroit, Mich., 500; Murray, Dougal & Co., Milton, Pa., 400; Pardee, Snyder, & Co., Watsontown, Pa., 200; Erie Car Works, Erie, Pa., 300 Harrisburg, Car Co., Harrisburg, Pa., 200; Michael Schall, York, Pa., 100; Schall & Shoop, Dauphin, Pa., 100; Carlisle Mfg. Co., Carlisle, Pa., 200 cars. Most of the cars are hopper gondolas.

Locomotive Works.—Mr. R. S. GRANT, of the Grant Locomotive Works, of Paterson, N. J., has been in Minneapolis to investigate the site where it is proposed to locate the works in case the plant is moved from Paterson to Minneapolis. It has been rumored that negotiations are pending for the sale to an English syndicate of the Grant and the Rogers locomotive works at Paterson. The speculation has been caused by the fact that ROBERT S. HUGHES, Secretary and Treasurer of the Rogers works; Superintendent REUBEN WELLS, of the same company; and Superintendent WILLIAM W. EVANS, of the Grant works, are at present in England. Their visit is said to be for the purpose of effecting the sale of the properties mentioned.

American Cement Tile Co.—At Sterling, Ill., to manufacture cement and drain tile. Capital stock, $21,000 Incorporators, F. W. WALZER, O. C. MASON, DANIEL C. BECKER.

Michigan Iron Ore Output.—Iron ore shipments continued as heavy in August as in July. For the four weeks ending Aug. 28, there were shipped in round numbers 1,035,000 tons of iron ore from the six ports of the four Lake Superior iron ranges, and for the last three days of the month about 120,000 tons more, making August shipments over 1,150,000 tons, or even larger by a few thousand tons, than the large shipments of July. The shipments of ore by water for the season will not fall 10,000 tons short of 4,550,000 tons. This is within half a million tons of the total product of 1888. Should shipments continue at their present rate for six weeks longer, 6,000,000 tons of ore will have been forwarded by the middle of October, and the season of navigation is not likely to close before Nov. 10 or Nov. 20.

The Buckeye Portland Cement Co., of Bellefontaine, O., has enlarged its factory to double its former capacity, and is making plans for doubling the capacity again next spring. The members of this company have had long experience in the manufacture of the Alamo Portland cement, used extensively by the U. S. Government, and are members of the Portland Cement Manufacturers' Association of Germany. Testimonials of experts show that the company is making a superior grade of Portland cement.

Railway Material Wanted.—The Gadsden Furnace Co., of Gadsden, Ala., wants a switch engine of 35 to 40 tons. R. B. SCOTT, Treasurer.

A dummy engine for hauling freight on a street railway. GEO. H. CORNELSON, Orangeburg, S. C.

A 20 to 25 ton engine and cars for a logging railway of 3-ft. gauge. Whitecastle Lumber & Shingle Co., Whitecastle, La.

Rails, cars, and machinery for an incline road one-half mile long. J. M. BERNHARDT, Lenon, N. C.

Second-hand rails and rolling stock for a narrow-gauge tramway. D. E. HAYNET, Covington, Tenn.

New Steam Engines.—A new engine, for both marine and stationary purposes, has been brought out recently. It is an upright, duplex, high speed engine, making from 1,500 to 3,000 revolutions per minute, and is instantly reversible. Mr. CHAS. G. EMERY, of New York City, tried the first engine of this kind in his steam launch, and he has taken up the manufacture. The Ames Mfg. Co., of Chicopee, Mass., is making them, and the Hussey Re-Heater & Steam Plant Improvement Co., 15 Cortlandt St., New York, has taken the general agency for their sale throughout the United States, Canada and Mexico. The inventor of the engine is Mr. E. G. SHORTT, of Carthage, N. Y., who has also invented an upright duplex steam pump on the same principles. This pump will shortly be put on the market by the Hussey Co.

Illustrated Advertising.—That some pertinent truths may be found in what are usually termed the dry reports of United States officials is readily apparent on reading what United States Consul WORTHINGTON says in a communication. "The trade journals that find their way into Malta do very much in attracting the attention of the people to our goods. A Maltese will frequently buy an article on the strength of an illustration. I have sometimes thought it would be money well invested if the advertisers in the trade journals would combine to send out, and cause to be intelligently distributed, a goodly number of said journals. An illustrated advertisement is eagerly read." Human nature is the same the world over, and everywhere we find interest aroused by the presentation of a handsome illustration of any object, however small. Thus these remarks of Mr. WORTHINGTON apply just as forcibly to our home trade, both East and West, where clear-headed business men have long known that a handsome illustration is the most efficient possible aid in selling a new article. One of the large supply houses in the West is noted for the numerous illustrations constantly shown by it. The manager of the company claims that no description can equal a pictured representation, and that every wood-cut procured has paid for itself a dozen times over during the first few months almost without exception. About a year since, on ordering nearly a hundred expensive wood-cuts of goods hardly in his line, yet for which he had received orders, his good judgment regarding the economy of such an expenditure was questioned by an outsider. His answer was: "The result will be the best proof." Each of the cuts appeared at intervals in the advertising columns of *The Electrical World*, and the net result at the end of 12 months was a profit of some $3,000 on a line of goods of which less than two hundred dollars' worth were carried in stock.—*Electrical World.*

The Ball Engine Co., of Erie, Pa., has re-opened its Chicago office (formerly with Messrs. Kingsland Bros.) at Room 408 Home Insurance Building, 205 La Salle St. Mr. H. A. KING, from the home office, will be in charge of this branch, and will reply to inquiries, furnish prices on engines, estimate on complete steam plants, etc., and attend to all business exactly as if addressed to the home office at Erie. The large and increasing demand for the Ball engine for electric lighting renders this move necessary.

BRIDGES AND CANALS.

Bridge Notes.—***Bangor, Me.***—The contract for removing the old wooden bridge over the Kennebec river, and building a new iron bridge, has been let to Cofrode & Saylor, of Philadelphia, Pa., at $25,000. There will be 1 span of 200 ft., and 2 of 100 ft. each.

Brunswick, Me.—The King Iron Bridge & Mfg. Co., of Cleveland, O., will begin work shortly on the Androscoggin bridge.

Warren, R. I.—The bridge committee is securing plans for a new bridge in place of the present Kelly's bridge. The plan which will probably be adopted contemplates a foot-way and also a carriage-way, the latter to be at least 20 ft. wide.

Johnstown, Pa.—A committee of 15 leading citizens

has been appointed by the Board of Trade to urge the rebuilding of the bridges, and to take measures looking toward the cleaning out of the rivers. The gentlemen appointed on this committee will urge immediate action of the borough authorities in building bridges.

Philadelphia, Pa.—The stone work on the new bridge which the Philadelphia & Reading Railroad Co. is building to carry a new branch track over the Schuylkill at Manayunk, has been begun, and a large force of workmen are employed to complete, if possible, that part of the work during the present season.

Memphis, Tenn.—The County Commissioners have received the following proposals for the iron bridge across Nonconnah creek: John H. Walker, Memphis, $4,500; Columbus Bridge Co., Columbus, O., $5,365; Penn Bridge Co., Beaver Falls, Pa., $5,450; Milwaukee Bridge Co., $5,623; Lane Bridge Co., Chicago, $5,660; Pittsburg, Bridge Co., $5,715; King Iron Bridge & Mfg. Co., Cleveland, O., $5,773; W. H. Converse, Chattanooga, Tenn., $5,800. The contract will be awarded to J. H. Walker.

Opelika, Ala.—The city will build a bridge over the Columbus & Western tracks. For particulars address the mayor.

Topeka, Kan.—The Board of County Commissioners has received bids for the construction of 5 bridges, 4 of which are to be iron, and the other stone; the iron bridges are to be over Post creek on the line between Shawnee and Wabaunsee counties; over Six Mile creek north of Auburn; over Tecumseh creek at Parson's crossing, and over the Shunganunga creek on Coddington road in Topeka township. Bids were presented on the iron bridges by the following companies: Wrought Iron Bridge Co., of Kansas City; George G. King Bridge Co., of Des Moines, Ia.; King Iron Bridge & Mfg. Co., of Cleveland, O.; Missouri Valley Bridge Co., of Leavenworth; St. Louis Bridge & Iron Co., of St. Louis; Lane Bridge & Iron Co., of Chicago; and the Columbus Bridge Co., of Columbus, O.——The contract for building a stone arch bridge over Walnut creek in Silver Lake township was let to H. I. Cook & Co., of Topeka, for $582.

New York State Canals.—Sealed proposals for the following work will be received by JAMES SHANAHAN Superintendent of Public Works, Albany, N. Y., until Sept. 27. Plans, specifications, etc., may be seen at Albany and at the office of the Division Engineer at Syracuse.

The following are this estimated quantities for rebuilding lock 8, Cayuga and Seneca Canal: 1 bailing and draining; 1,000 cu. yds. all excavation, except lock masonry; 900 cu. yds. excavation of lock masonry; 800 cu. yds. embankment; 300 cu. yds. lining; 250 cu. yds. puddling; 50 cu. yds. vertical wall in cement; 480 cu. yds. dressed faced masonry; 525 cu. yds. rubble masonry in chamber wall; 6,000 ft. B. M. white oak timber per M.; 4,500 ft. B. M. white pine timber per M.; 4,500 ft. B. M. hemlock timber per M.; 60 lin. ft. snubbing posts set; 2,000 lbs. wrought-iron; 300 lbs. cast-iron; 2,000 lbs. spikes and nails; 1 lead cement; 4 bailing out and replacing grates. Deduct materials furnished by State—150 cu. yds. face stone at 38 per yd.; 550 cu. yds. backing stone at $2,50 per yd. The amount of deposit required with bid for above lock is $1,500. The amount of labor bond required for above lock on execution of contract, $2,000. The amount of bond for faithful performance of contract on execution of contract, $4,000.

The following are the estimated quantities for putting in machinery in locks 9 and 10, Oswego Canal: Two bailing and draining; 2,000 cu. yds. all excavation: 1,600 cu. yds. embankment; 50 cu. yds. vertical wall in cement, including coping; 470 lin. ft. of 30-in. vitrified pipe laid and cemented; 100 lin. ft. 24-in. vitrified pipe laid and cemented; 3,600 ft. B. M. white oak timber, etc., per M.; 3,000 ft. B. M. white pine timber, etc. per M.; 16,000 ft. B. M. hemlock timber, etc., per M; 3,600 lbs. wrought-iron; 200 lbs. spikes and nails; machinery; 2 water wheels (28-in. in place); 2 friction clutches in place; for all machinery in place connected with water-wheels and clutches in complete working order as per plan. The above items are for about 6,000 lbs. machinery, castings, and shaftings fitted and in place. The amount of deposit required with bid for putting machinery in locks 9 and 10, Oswego Canal, $250 for each lock. The amount of labor bond required for putting machinery in lock No. 9, Oswego Canal, on execution of contract, $1,000. Same amount for lock No. 10. The amount of bond for faithful performance on execution of contract for putting machinery in lock No. 9, Oswego Canal, $1,000. Same amount for lock No. 10.

Clarion, Pa.—The following proposals for an iron bridge, 224 ft. span, 18 ft. roadway, over the Clarion river, have been received by the County Commissioners: Wrought Iron Bridge Co., Canton, O., $10,450; Massillon Bridge Co., Massillon, O., $10,830; Pittsburg Bridge Co., Pittsburg, Pa., $10,850; Champion Bridge Co., Wilmington, O., $10,900; Groton Bridge Co., Groton, N. Y., $10,-900; Berlin Iron Bridge Co., East Berlin, Conn., $10,990; Edge Moor Bridge Co., Wilmington, Del., $10,995; Penn Bridge Co., Beaver Falls, Pa., $11,000; Mt. Vernon Bridge Co., Mt. Vernon, O., $11,200; Youngstown Bridge Co., Youngstown, O., $11,256; King Iron Bridge & Mfg. Co., Cleveland, O., $11,300; Columbus Bridge Co., Columbus, O., $11,300; Columbia Bridge Co., Dayton, O., $11,400; Lane Bridge & Iron Works, Chicago, Ill., $11,750; Brackett Bridge Co., Cincinnati, O., $12,000; Dean & Westbrook, New York, $12,100; Queen City Bridge Co., Cincinnati, O., $12,300. The contract was let to the Wrought Iron Bridge Co.

ELECTRICAL.

Electric Lighting.—*Poughkeepsie, N. Y.*—A franchise has been granted to FRANK RIDLON, of the Wright Engineering Co., Boston, for an electric light, heat and power system.

Union City, Tenn.—An electric light plant will be put in by A. P. WADDELL and F. W. MOORE, of Dresden.

Hopkinsville, Ky.—An electric light franchise has been granted to S. H. TURNER.

Athens, Ga.—A contract has been let for lighting the city by electricity.

Rome, Ga.—A contract for electric lighting will be made with the Rome Gas Light Co. There will be 24 arc lights and 34 incandescnt lights.

Savannah, Ga.—Proposals for lighting the city for a term of years will be received by Mr. REBARER, City Clerk, until Oct. 15. The bids will be for 50 arc or 250 incandescent lights for one year from Jan. 1, 1890, and for 2 to 6 years from Jan. 9, 1891.

Columbus, Ind.—The city proposes to put in an electric light plant of its own.

Marquette, Mich.—The city has contracted with the Keystone Construction Co., of Chicago, for the installation of a 750-light Westinghouse plant, to be operated by water-power which is owned by the city.

Peoria, Ill.—The Jenney Electric Light Co. has let contracts for its power house and plant at $45,000. There will be 2 Corliss engines, of 375 and 150 H. P.

Lexington, Ill.—There is some talk of putting in an electric light plant in connection with the proposed water-works, but no definite action has yet been taken.

Duluth, Minn.—The Brush Co. has been awarded the contract for supplying the city with a municipal arc lighting plant consisting of two 60-light Brush dynamos, 120 double carbon Brush lamps, and their appurtenances.

Sioux City, Ia.—The city has made contracts with the Sioux City Gas Light Co. and the Sioux City Gas & Electric Co. The electric light contract was a 5-year grant, while the gas light franchise was for the same period, provided that at any time after October 1, 1889, at the option of the City Council, arc lights, to be furnished under contract of even date between Sioux City and the Sioux City Electric Light Co., may be substituted for gas lamps in whole or in part. In the electric light franchise the first contract shall not be less than 35 lights to be increased as often as the City Council shall order upon 30 days' written notice, and not less than 25 lights shall be ordered at any one time, unless otherwise agreed to by the parties in interest.

Norfolk, Neb.—Proposals will be received for putting in an electric light plant, to be operated by water-power; distance about 1 mile for pole line. For particulars address GEO. A. LATIMER, City Engineer, Norfolk, Neb.

Kyle, Tex.—For particulars of the proposed electric light plant address H. HELLMAN.

Sydney, New South Wales.—The Municipal Council invite applications for the right to establish a system of electric lighting in the streets, lanes, and reserves of the city. Such system may include the application of the light for domestic purposes, and the use of electric power generally. Upon a satisfactory system being submitted and approved, the Council will be prepared to enter into an agreement for the lighting of the whole or a section of the city, as may be considered advisable. Further particulars may be obtained at the offices of the Agent-General for New South Wales, 9 Victoria St., London, England, HENRY J. DANIELS, Town Clerk, Sydney, N. S. W.

SEWERAGE AND MUNICIPAL.

Bath Beach, N. Y.—The Bath Beach Sewer Commission, consisting of A. V. B. VOORHEES, President; JOHN V. VAN PELT, Treasurer; CORNELIUS FERGUSON, Jr., Secretary; FREDERICK DEMUND, M. D., and GEORGE E. NOSTRAND, have decided on a plan for the sewerage of Bath Beach and Bensonhurst. The system is to be in working order by May 1, 1890, with a penalty of $100 a day for every day beyond that time. During the past summer, in company with Engineer SAMUEL H. MCELROY, the commission visited New London, Ocean Grove, Asbury Park, and Atlantic City to learn their systems. The plan adopted is like that of Ocean Grove, New London, and Asbury Park, and is known as the direct drainage system. The discharging mains will run 700 ft. into Gravesend bay. The district to be sewered will comprise all that between 15th St. on the northwest, 84th St. on the northeast, 23d St. on the southeast, and Gravesend bay on the southwest. The outlet pipe is to be of iron 16 ins. in diameter, and will run to a depth of 9 ft. in low water. The system, as now provided for, will run 11 miles and will cost $95,000. Many of the streets within the district fixed upon are not to be sewered. The entire system projected for Bath Beach and Bensonhurst will require 40 miles of mains and cost about $220,000. This system is expected to carry off the sewage for a population of 100,000.

Sewers.—*Lansingburg, N. Y.*—Ordinances have been prepared for the construction of lateral sewers.

Morristown, Pa.—An ordinance authorizing the construction of a sewer in Marshall St. has been repealed, but as a contract has been awarded by the Sewer Committee at $8,000, which contract only required the approval of the Council, this action will probably be reconsidered.

Philadelphia, Pa.—A resolution has been adopted authorizing the preparation of an ordinance for a loan of $250,000 to relieve the Cohocksink sewer.

Birmingham, Ala.—New proposals are wanted for the construction of the Morris Ave. sewer. For particulars address the mayor.

Portland, Ore.—The extension of the Tanner creek sewer is progressing. Owing to the nature of the ground excavated, a concrete foundation has to be laid.

Ellensburg, W. T.—The contract for a complete sewerage system has been let to J. T. Stroud. Work will be commenced at once in the business section of the city. The system was designed for a population of 10,000 by W. P. MASON, a sanitary engineer, who will superintend the construction.

Pasadena, Cal.—About three years ago the city purchased land for a sewer farm, and is now suing property owners for a right-of-way for its outfall sewer to the farm.

WATER-WORKS.

NEW ENGLAND.

Bethel, Me.—The village has contracted for 25 hydrants at $800 a year, for a term of 20 years.

Caribou, Me.—The works will be put in operation early in October.

Andover, Mass.—Construction of the new works has been begun. See ENGINEERING NEWS for Aug. 10.

Boston, Mass.—The connections necessary to give Charleston water from the Cochituate and Sudbury system, instead of from the Mystic, are nearly completed. A loan is necessary before the work can be brought to a close.

City Engineer Jackson has submitted the following estimates of the cost of the water supply for the next 20 years.

Construction of basins 5, 6, 7 and 8 and Whitehall pond, including change of roads.....	$2,750,000
Amount to be paid to towns to take sewage out of watershed	100,000
Land damages, mill damages, excavating and draining swamps and the purchase of lands and buildings to prevent pollution	700,000
Engineering, superintendence and contingencies.....	355,000
Total	$3,905,000

In referring to the above the Mayor says that in 1876 the State Board of Health estimated that 7 per cent. of the water flowing into the upper Mystic pond was drainage from factories. The Mystic supply is said to be insufficient in dry years, and in addition, it is always impure.

Lynn, Mass.—The $50,000 loan was taken by Kidder, Peabody & Co. at a little above 108. The interest will be about 3½ per cent.

MIDDLE.

Albany, N. Y.—The Special Water Commission has recently made a report to the Common Council regarding the condition of the works now being constructed. Three new reservoirs are being built to store the waters of Patroon's and Sand creeks, and thereby increase the gravity supply. These will have a combined capacity of about 50,000,000 galls., and will add from 4,000,000 to 5,000,000 galls. to the city's daily supply. Regarding the driven wells, the Commission says that 390 have been driven by Andrews & Bro., but no formal test, so far as known to the commissioners, has been made. The yield is less than expected, and the contractors have failed to comply with a recent order to make a test within 15 days. It has not been demonstrated that the driven wells are a failure, and the contractors are still at work putting down new ones.——Owing to unforeseen circumstances, the letting of contracts for pipe, advertised for Sept. 10, has been indefinitely postponed.

Buffalo, N. Y.—Comptroller Jos. E. BARNARD was to receive bids until Sept. 19 for $145,000 of 20-year, 3½ per cent. bonds, to refund 7 per cent. bonds due Oct. 1. The total debt of the city is now $9,654,581.

Cuba, N. Y.—King & Keith, Olean, N. Y., have recently completed works here. Pipe and specials were bought of the Jackson & Woodin Mfg. Co., Berwick, Pa. Ludlow valves and hydrants were used.

Rouse's Point, N. Y.—Bids for works to cost $24,000 or less were opened Sept. 20. F. S. PECKE, Watertown, N. Y., is the engineer.

Troy, N. Y.—EDWARD DOLAN has been appointed by the Water Commissioners as superintendent, to succeed PALMER H. BAERMAN, who recently resigned to accept the position of city engineer.

Du Bois, Pa.—The United States Water Co., Ltd., is building works, with C. J. SHUTTLEWORTH as Engineer. The material is from the Michigan Pipe Co., of Bay City Mich.

Philadelphia, Pa.—ISAAC S. CASSIN is reported by the Philadelphia *Press* as favoring a new water supply to be drawn from the upper Delaware drainage area. He is wisely opposed to the construction of works by a private company, and thinks it would be bad engineering to lead water by a 48-in. main from the new East Park reservoir to the Kensington reservoir, as has been proposed, since this would make a loss of about 20 ft. head.

Irwin, Pa.—The new works were begun Sept. 16.

Pottstown, Pa.—It is said that several miles of 24 or 30-in. pipe will soon be laid, and a new reservoir, pumping station and plant be put in by the Gas & Water Co. Estimated cost, $125,000 to $150,000.

Rochester, Pa.—The Rochester Water Co. was unable to contract with the village, and will not attempt to build works before next year.

Sidney, N. Y.—The works will be finished Oct. 1. The pipe has been furnished by the Warren Foundry & Machine Co., Phillipsburg, N. J., and the specials by the Builders' Iron Foundry, Providence, R. I. Ludlow valves and hydrants are used. Wm. B. Rider & Son, So. Norwalk, Conn., are designing, and RALPH B. CARTER, constructing engineers.

Watkins, N. Y.—E. A. GILLETT, Village Clerk, has sent us the following:

An appropriation for water-works and sewers, not to exceed $75,000, was voted Aug. 26. Commissioners have been appointed, but they have not organized. T. DAVIS, Jr., is temporary chairman. Preliminary surveys have been made by C. Ph. BASSETT, Newark, N. J. Population 3,000.

Freehold, N. J.—A pumping supply of 60 galls. a minute has been obtained from a 4½-in. artesian well, 92 ft. deep. After the well is cased it may be sunk deeper.

Washington, Pa.—Additional land for storage reservoirs has been bought.

Washington, D. C.—Three large Eddy valves were recently shipped to the works. One was 48 ins. in diameter and weighed 9 tons. Work on the tunnel has been practically abandoned, but $40 having been spent on it in August, while $35,000 was spent on the new 48-in. main.

Centreville, Md.—We are indebted to W. F. HARMAN, Treasurer, for the following:

The works will be put in operation Dec. 15. R. A. CAIRNS, 35 Broadway, New York, is the engineer. A Knowles pump and Ludlow valves and hydrants will be used. Tippett & Wood, of Phillipsburg, N. J., furnish the stand-pipe, and the McNeil Pipe & Foundry Co., Burlington, N. J., the pipes and specials.

SOUTHERN.

Covington, Va.—The works are nearly completed.

Wheeling, W. Va.—Supt. CUMMINGS fears that new pumping machinery will be necessary to force water to the high-pressure reservoir, now nearly completed. The old machinery is not adapted to this work.

Blowing Rock, N. C.—Works are projected by Charlotte parties.

Atlanta, Ga.—The works will be enlarged, and $250,000 of bonds will be issued to meet the expense.

Augusta, Ga.—Address Mayor REILLY for information regarding the proposed pumps at the artesian well on the U. S. arsenal grounds.

Macon, Ga.—The Anglo-American Water & Gas Co. will make extensive improvements. The above is the organized name of the English capitalists who recently purchased the Water and Gas Works.

Columbia, Ala.—The city will complete the works now in progress Mar. 1, 1890. Water will be pumped to a 50,000-gall. stand-pipe, 70 ft. high, from an artesian well with a yield of 100 galls. a minute. The well is down, but the other work has not been done. Population, 1,200.

Chattanooga, Tenn.—The Chattanooga Water & Power Co. are building a $10,000 system of waterworks to be run in connection with their incline and street railway. The contracts have all been let.

Humboldt, Tenn.—Works may be built by C. HOWARD, Memphis, Tenn.

McMinnville, Tenn.—A franchise has been applied for by Burroughs & Co.

Covington, Ky.—Miss JESSIE MENARD, Nicholasville, Ky., informs us that the contract for the reservoir on Newport Heights was awarded Sept. 4 to D. Shanahan & Co., Richmond, Ky. As noted last week, in our list of bidders for this work, the price is $225,706.

Winchester, Ky.—Address the mayor.

Lexington, Ky.—Another dam and reservoir have been proposed.

Maysville, Ky.—It is reported that on Sept. 6 the pumps stopped working, owing to trouble with the suction pipe, and that the mills and factories depending upon city water were obliged to shut down.

Princeton, Ky.—The town may issue $10 000 of bonds for the construction of water-works.

NORTH CENTRAL.

East Palestine, O.—J. B. STRAWN, Engineer, has sent us the following

Bids for building works were opened Sept. 2, as previously advertised in ENGINEERING NEWS. Three proposals were received for constructing the entire plant as follows:

McCormick & Moran, Pittsburg, Pa., $31,000; Chandly Bros. & Co., Beaver Falls, Pa., $23,000; M. Philbin Construction Co., Cincinnati, O., $23,867. The first bid was for works including two 750,000-gall. pumps, two tubular boilers, a brick pump-house, 28 x 40 ft., a 300,000-gall. brick-walled reservoir, 3.74 miles of 12 to 4-in. cast-iron pipe, 36 hydrants, and 27 gates. The second bid for was the same as the first, with the exception that it was for but one pump and boiler. The third bid was like the first, and the contract was awarded to the Philbin Co., after changes had been made, so that the final contract was for but one pump and engine, and exclude the reservoir, the price being $18,697.

The works are to be completed by Dec. 1. A Gordon pump, Bourbon valves and hydrants, Bingham & Taylor gate-boxes, and Lake Shore Foundry pipe will be used.

Gladstone, Mich.—JAS. WILSON, Engineer, has sent the following:

The works were put in operation Sept. 15. The pumps and boilers are from the Buffalo (N. Y.) Steam Pump Co.; the pipe and specials from the Lake Shore Foundry, Cleveland, O. Galvin valves and hydrants are used. Keating & Sheehan, Detroit, Mich., did the trenching and pipe-laying, which included 700 ft. of 16-in. intake-pipe, the outer end of which is in 32 ft. of water. There are 4½ miles of mains and 32 hydrants. Cost, $33,000.

Monroe, Mich.—CHESTER R. MCFARLAND, Constructing Engineer, has sent us the following:

The Monroe Water Co. will put its works in operation Dec. 1. They were designed by E. F. FULLER, New York City. Two 1,500,000-gall. Worthington pumps force water from Lake Erie directly to the mains. The boilers are from the Ames Iron Works, Oswego, N. Y.; pipe and specials from Lake Shore Foundry, Cleveland, O. Ludlow valves and hydrants are used. Snyder & Williams, Dayton, O., are laying the pipe, and H. C. THACHER, Toledo, O., the intake pipe. C. W. SCOTT is Secretary. Population, 6,000.

Denver, Ind.—Small works will be built here.

Wyandotte, Mich.—The Galvin Valve & Hydrant Co. inform us that they were awarded the contracts for hydrants at Wyandotte, and the Galvin Brass & Iron Works the contract for valves, and not the latter company the contract for both valves and hydrants, as stated in our issue of Aug. 24.

Galesburg, Ill.—J. C. STEVENS, City Clerk, has sent the following:

Bids were opened Sept. 2 for the construction of a supply well 30 ft. in diameter and 50 ft. deep, with walls 3 ft. thick at the bottom and 2 ft. thick at the top, and also for a pump-well 35 ft. in diameter and 35 ft. deep, the two wells to be connected by a 16-in. pipe placed about 40 ft. from the surface. The bidders and bids were: Northwestern Construction Co., Chicago, $19,400; L. B. Stevens, Toledo, O., $16,575; W. M. Chisholm, $16,200; Michael Stopper, Cincinnati, O., about $15,500.

Ripon, Wis.—X. D. STONE has sent us the following:

C. E. Gray & Co. are to build works, pumping the supply from a filtering gallery to a stand-pipe. The stand-pipe will be 15 by 100 ft., and the pumps will have a daily capacity of 1,500,000 galls. There will be 6½ miles of 12 to 6-in. cast-iron mains and 75 hydrants. W. F. GOODHUE is the designing engineer. The estimated population is 5,000.

NORTHWESTERN.

Enmetsburg, Ia.—The contract for the well has been let to Deckerman Bros., a local firm, and bids are now invited for putting in a system of water-works. Address B. E. KELLY, Mayor.

Albert Lea, Minn.—Probably works will soon be built, but nothing definite has been done.

Anoka, Minn.—Works are being built by Sykes & Co.

Ely, Minn.—Small works will be completed Oct. 1 by the village. There will be 2,000 ft. of 5-in. pipe and 6 hydrants. A No. 9 Knowles pump will be used.

Owatonna, Minn.—The artesian well is down 350 ft. No further contracts will be let until water is found, after which the town proposes to build a stand-pipe system at a cost of $40,000. Population, 4,000.

Belleville, Kan.—The Pond Engineering Co. has been awarded the contract for the pumping engines and boilers.

Harrison, Neb.—Works will not be built before next spring.

Tekamah, Neb.—E. B. ATKINSON, City Clerk, has sent us the following:

It has been proposed to let contracts in October for works to cost about $15,000. Water will be pumped from wells to a reservoir. The village will own the works. Population, 1,800.

Nampa, Idaho.—Negotiations are pending for the completion of the Ridenbaugh canal.

Eagle Rock, Idaho.—The Idaho Canal Co., with C. C. TAUTPHAUS as President and Superintendent of Construction, have begun a system of canals the total length of which will be about 67 miles. The head-gates will be located at a point 10 miles above Eagle Rock, on the Snake river, and ditching has been started. On the first 1½ miles there will be 8 head-gates, each 9 ft. wide, and for the first 1½ mile the ditch will be about 60 ft. wide, and have an average depth of 12 ft. The greater part of the main canal will be but 40 ft. wide, with a carrying cappacity of 100,000 cu. ins. At a point 13 miles from the river the canal will divide into three branches. It is expected that the main canal will be ready for use by next season and the three branches the following season.

SOUTHWESTERN.

Baird, Tex.—Address W. E. Gilliland.

Bonham, Tex.—Address the Mayor.

Cleburne, Tex.—Surveys for works are being made, and proposals for artesian wells are desired.

Dallas, Tex.—Proposals will be received until Sept. 25 for lining 2 storage reservoirs. There will be 37,000 sq. yds. of slope lined with brick, and 67,000 sq. yds. of bottom lined with cement. J. D. COOK, Toledo, O., is Consulting Engineer, and W. MCGRAIN is City Secretary.

New Birmingham, Tex.—T. HOWARD BARNES' Engineer of the New Birmingham Iron & Land Co., informs us that water-works are necessary. Nothing has been done to secure them.

Rockdale, Tex.—Address the Mayor or the City Council regarding projected works.

Taylor, Tex.—The contract for a 100-ft. stand-pipe has been let to——KELLY.

Denver, Col.—We are indebted to P. ALLEN, Engineer and Superintendent, for the following:

The Citizens' Water Co. closed contracts Sept. 12 with the E. F. Hallack Lumber Co., for 3,000,000 ft. B. M. 2 by 6-in staves, for their wooden conduit, which is to bring water to Denver. Water is to be collected at the mouth of Platte Cañon, about 20 miles from the city limits, above all chance of contamination, from gravel beds, by means of horizontal wells or galleries. Contracts were also let to Rhodes Bros. for 300,000 half-inch steel rods or bolts 9 ft. long, manufactured by Oliver Bros., Pittsburg, Pa.

Pueblo, Col.—The water-works Trustees have ordered built new settling reservoirs and a new ditch. Cost, $80,000.

PACIFIC.

Sprague, Wash.—Contracts have been let for a Holly system of water-works. They are to be finished by Jan. 1, and will cost about $25,000.

Bear Valley, Cal.—The Bear Valley Extension Water & Pipe Line Co. has been incorporated to build and maintain works either for irrigating purposes or domestic water supply. The capital stock is $75,000, of which $48,000 has been subscribed. The offices are at San Bernardino. Among the incorporators are: E. L. MAYBERRY, Alhambra; H. L. DREW, San Bernardino; and CLARENCE STEWART, Riverside.

San Pedro, Cal.—Water-works and electric lights are being discussed by the San Pedro Town Co., of which F. A. BLAKE is Secretary.

ARTESIAN WELLS.

Macon, Ga.—The Palmer Mfg. Co. is putting down a well.

Shreveport, La.—The Texas & Pacific Ry. Co. are sinking an artesian well to secure water for their engines.

Cleburne, Tex.—Proposals for artesian wells for water-works are wanted. Address the Mayor.

Terrell, Tex.—Another artesian well is to be sunk at the North Texas Insane Asylum.

Parker, Dak.—The contract for the well has been awarded to J. F. Gray, Chicago, Ill., at $4 per ft. Jas. Cunningham, Woonsocket, Dak., bid $4.80 per ft., and Gray Bros., Milwaukee, Wis., $4 per ft. for the first and $4.50 for the second 500 ft.

Santa Fé, N. M.—The Santa Fe Artesian Well Co. has been organized, with the following directors: F. W. CLANCY; C. F. A. FISCHER, GEO. DRAUGHAN, S. SPIEGELBERG, and W. T. THORNTON. The company propose to sink a 1,000-ft. test well in Santa Fé valley. Copeland Bros., Denver, are on the ground trying to secure the contract.

Charleston, S. C.—Bids for a well 1,300 ft. will be received until Oct. 1 by the Charleston Ice Mfg. Co. The well will be cased with an inner and outer flush-joint casing, 1,000 ft. to be 12, and 300 ft. to be 10 ins. in diameter at the bottom. Steam will be furnished by the above company.

T. B. ALSTON, 28 Coming St., Charleston, S. C., requests bids for a well on a plantation. The well must be 2 ins. in diameter, flow 25 to 30 galls. a minute, and would probably be from 300 to 400 ft. deep.

IRRIGATION.

Pueblo, Col.—C. P. ALLEN and R. HOLME have contracted with the Bessemer Ditch Co., of Pueblo, Col., to construct an inverted siphon across the St. Charles river about 7 miles from Pueblo. The siphon is to be made of Texas pine staves, banded with steel bands. Internal diameter, 54 ins. Length of siphon, 4,000 ft. It will have a hydraulic head varying from 15 to 75 ft., with a grade of 30 ft. to 4,000. It is calculated to carry 180 cu. ft. per second. Contract price, $20,000.

Ogden, Utah.—The Bear Lake & River Canal Co. has awarded the contract for building a part of its canal to WM. M., GARLAND, Kansas City. The canal will be 150 miles long, 40 ft. wide and 10 ft. deep. It begins at Bear lake, Ida., and two miles of its course is through Montana. It has been proposed to supply Ogden and other towns along the canal with water for domestic purposes. It is said that construction will be begun at once, and be finished by April 1, 1890. Estimated cost, 4,000,000. J. R. BOTHWELL is President of the Company.

North Yakima, Wash.—It is stated that CHAS. A. GREGORY, WM. J. BRYSON, and CHAS. A. YOUNG of Chicago, WALTER N. GRANGER, J. D. MCINTYRE and ALBERT KLEINSCHMIDT, of Helena, Mont., have purchased 1,000,000 acres of land in Washington and Montana from the Northern Pacific Ry. Co., and that these gentlemen will construct large irrigating works. Surveying parties have already been started out. The first operations will be in the Yakima country in Washington and between the West Gallatin and Madison rivers in Montana.